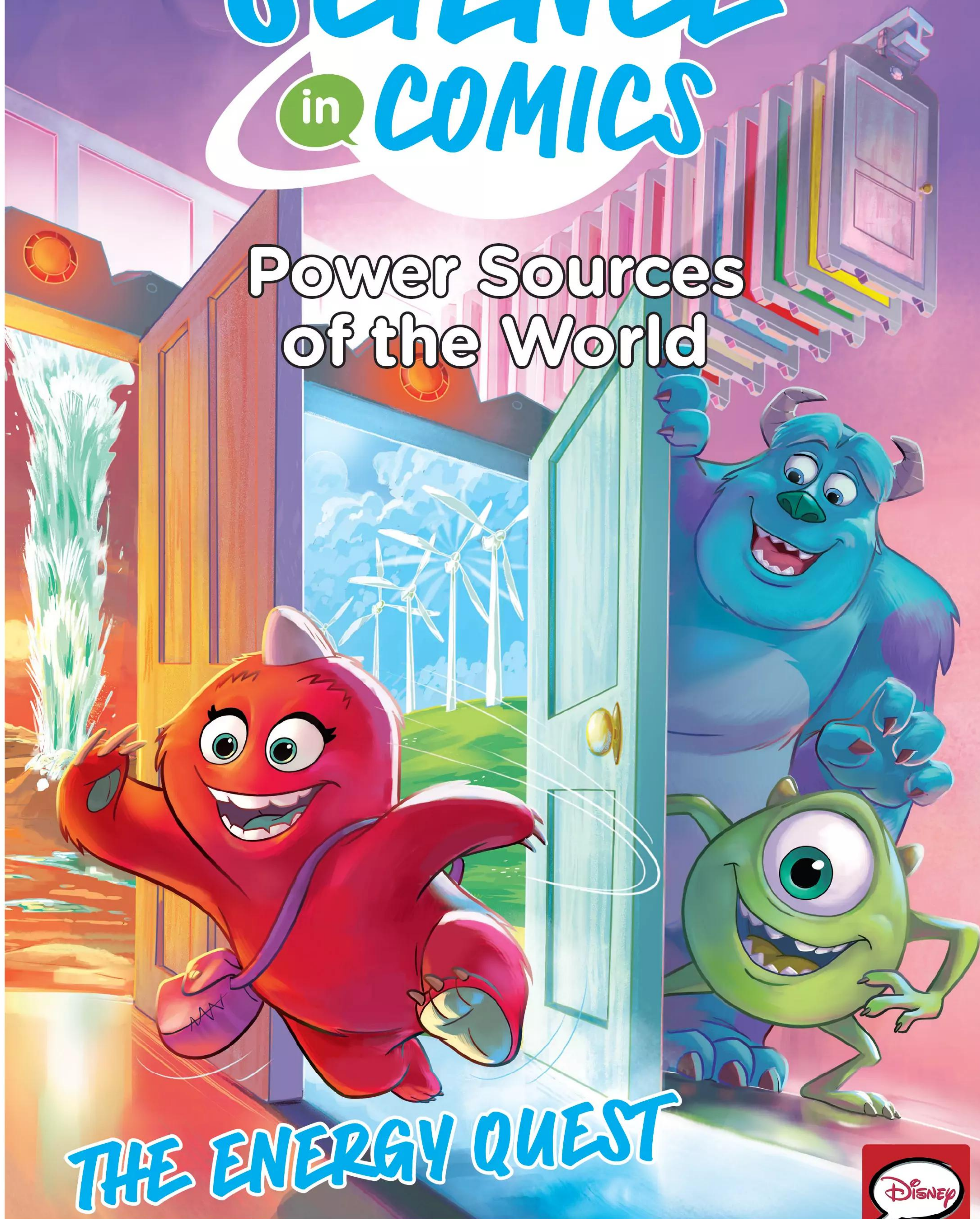


SCIENCE in COMICS

Power Sources of the World



THE ENERGY QUEST

Disney **Science in Comics** is a series of comics titles designed to build a sound knowledge base for kids 8–12 years old, on science themes related to features and secrets of the world around us.

POWER SOURCES OF THE WORLD: *THE ENERGY QUEST*

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Meet Lucy and her monster pals



Ten-year-old Lucy is the **smartest little monster** in her school class, with **big hopes and dreams** for the future. As an aspiring power plant worker at Monsters, Inc., she is **very determined** and **must know everything about energy**. Her never-ending curiosity can get her into trouble, like falling through a Laugh Floor door to the human world!

James P. Sullivan, commonly known to his friends and coworkers as Sulley, is the **CEO of Monsters, Inc.** Back in the days when the company focused on scaring children, Sulley was the **top Scarer**. However, he was and continues to be **a gentle giant** at heart, popular with his employees and the kids he meets—humans and his own kind.



Mike Wazowski is a **feisty and quick-witted**, one-eyed, green ball of a monster. Mike works at Monsters, Inc., as a jokester, trainer, and assistant to his **longtime best friend, Sulley**. Despite his excellent **sense of humor**, he can be known to react to unexpected situations with **panic and hysteria**... like when little monsters go missing at Monsters, Inc.!

Celia Mae works at Monsters, Inc. Formerly a receptionist, Celia is now a **Laugh Floor supervisor**. Though she is a monster with live snakes for hair, she is anything but a Medusa. Celia is **sweet, beautiful, and humorous**, particularly with Mike, her loving and devoted boyfriend, who calls her Schmoopsie-Poo.

CELIA



NEEDLEMAN

Needleman helps Smitty with the **cleaning and maintenance** of Monsters, Inc. Or, rather, he bosses Smitty around while they work the Laugh Floor! This behavior often leads to **quarrels** between the two monsters and, sometimes, **unfortunate accidents**. Although he would never admit it, Needleman is just as **silly** as Smitty!



Smitty is a janitor at Monsters, Inc. While he is young, sluglike, and **impulsive**, he and his coworker Needleman are **committed to their jobs**. They both deeply admire Mike and Sulley and sometimes get starstruck in their presence!

SMITTY



WHEN SPARKS FLY

Today, in Monstropolis, Monsters, Inc. is excited to welcome a school field trip.

So, you see, human kid laughter provides Monstropolis with energy! But it also pays my salary, heh heh!

But what is energy?

Energy's all around us. We store it and distribute it so it can help us do everything: live, work, play, and survive!

FLOOR SUPERVISOR

Good answer! I couldn't have put it better myself. What's your name?

Well, you give us a call after you finish your education. We need smart young monsters like you!

I'm Lucy! I want to work at your power plant when I grow up!

But do humans take their energy from their laughter and bottle it in canisters like us? I need to know for my Human Studies paper!

That's a good question.
I don't know if I know
the answer to that...



Oh, would you look at that, it's
time for lunch! Let's hurry along
so Needleman and Smitty can
clean the Laugh Floor!



Howdy!

Heh heh,
hi!

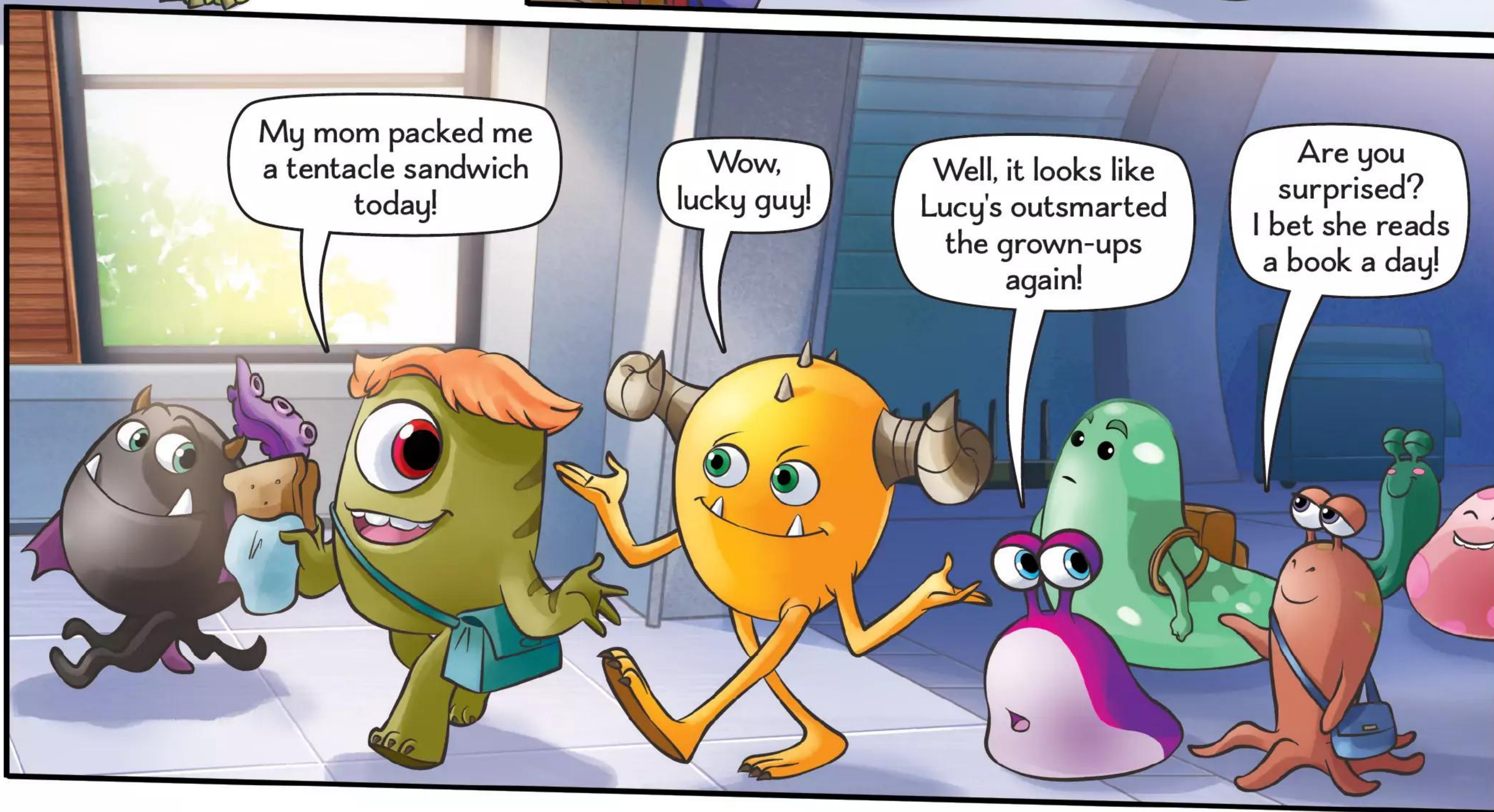


My mom packed me
a tentacle sandwich
today!

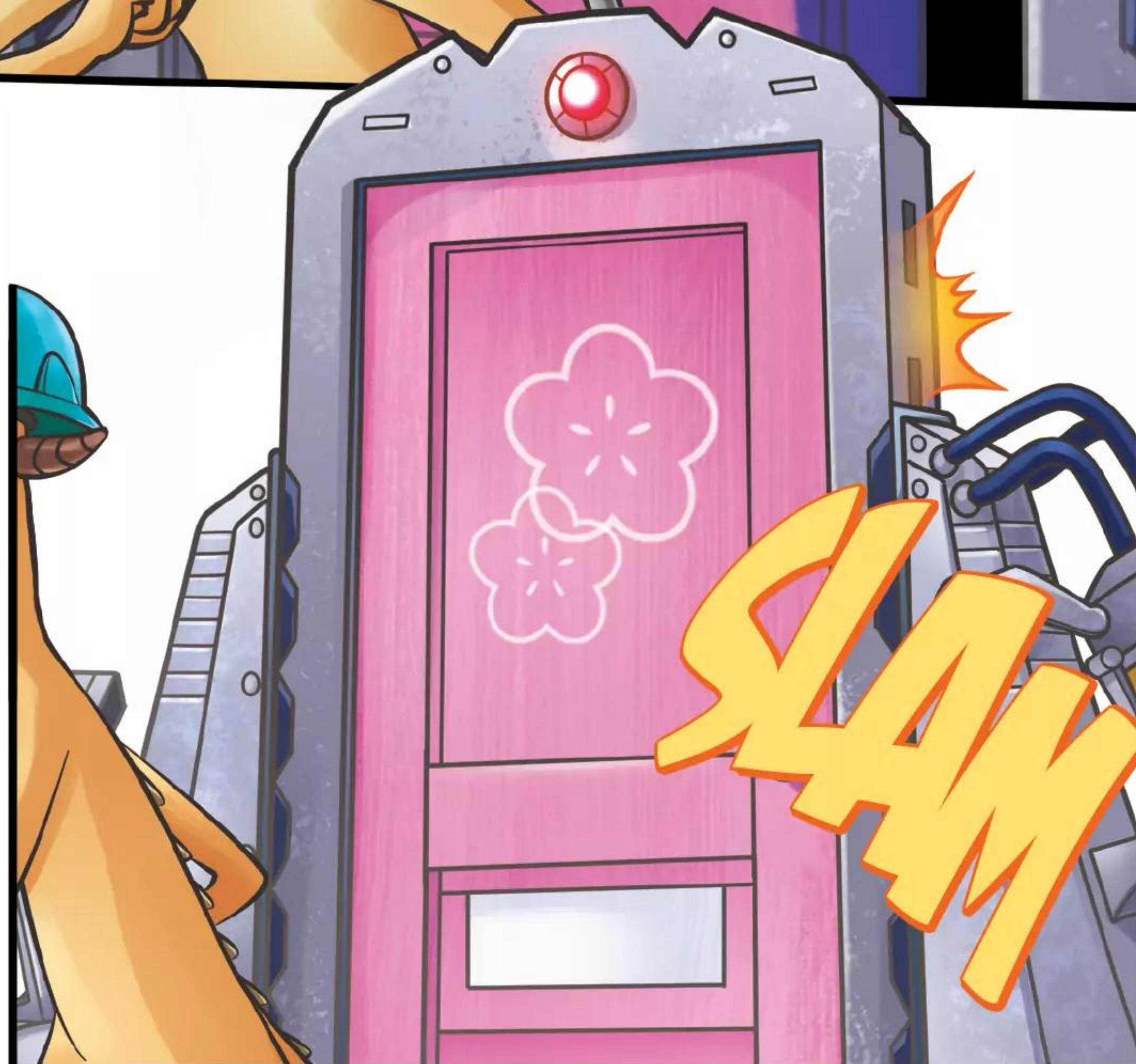
Wow,
lucky guy!

Well, it looks like
Lucy's outsmarted
the grown-ups
again!

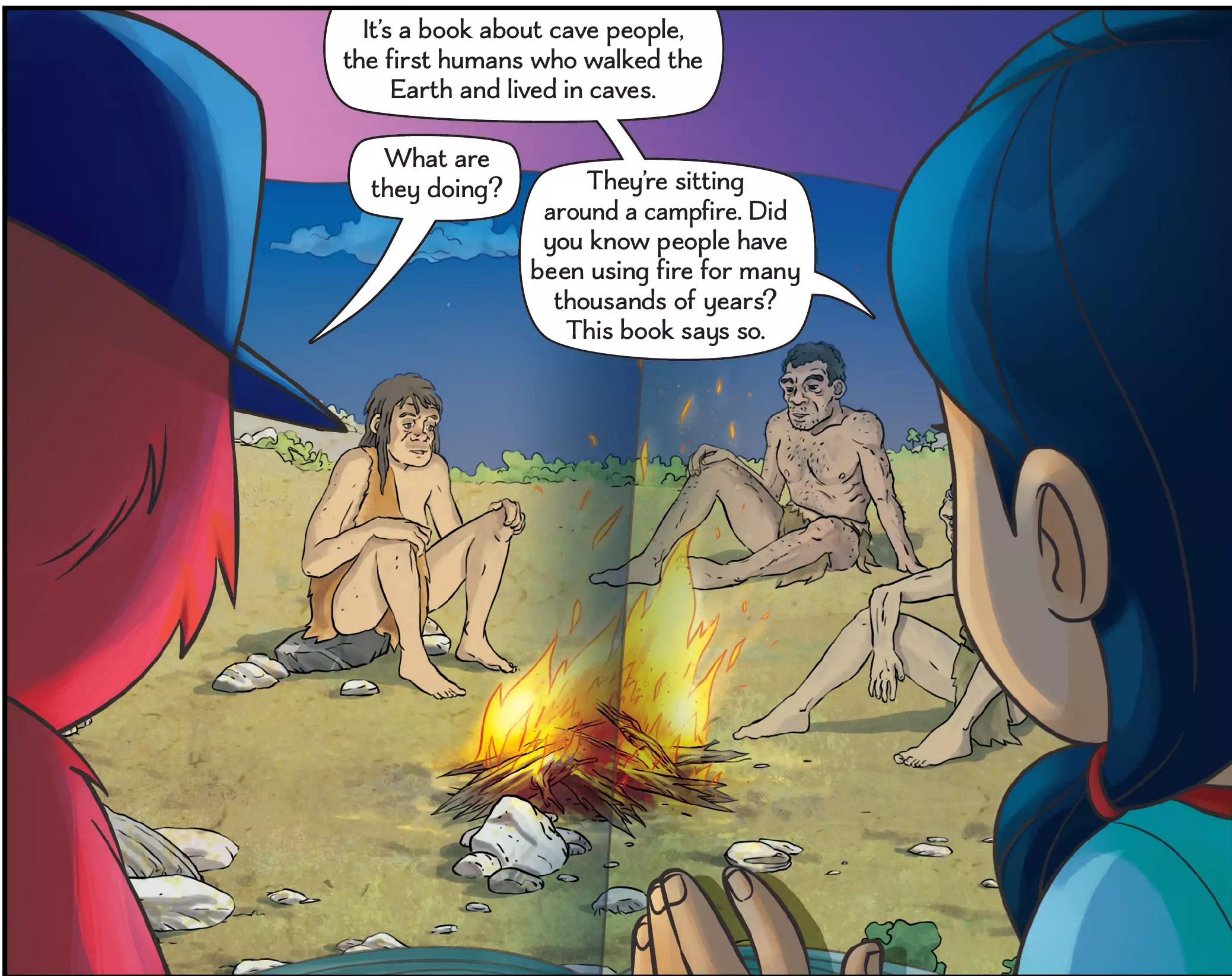
Are you
surprised?
I bet she reads
a book a day!

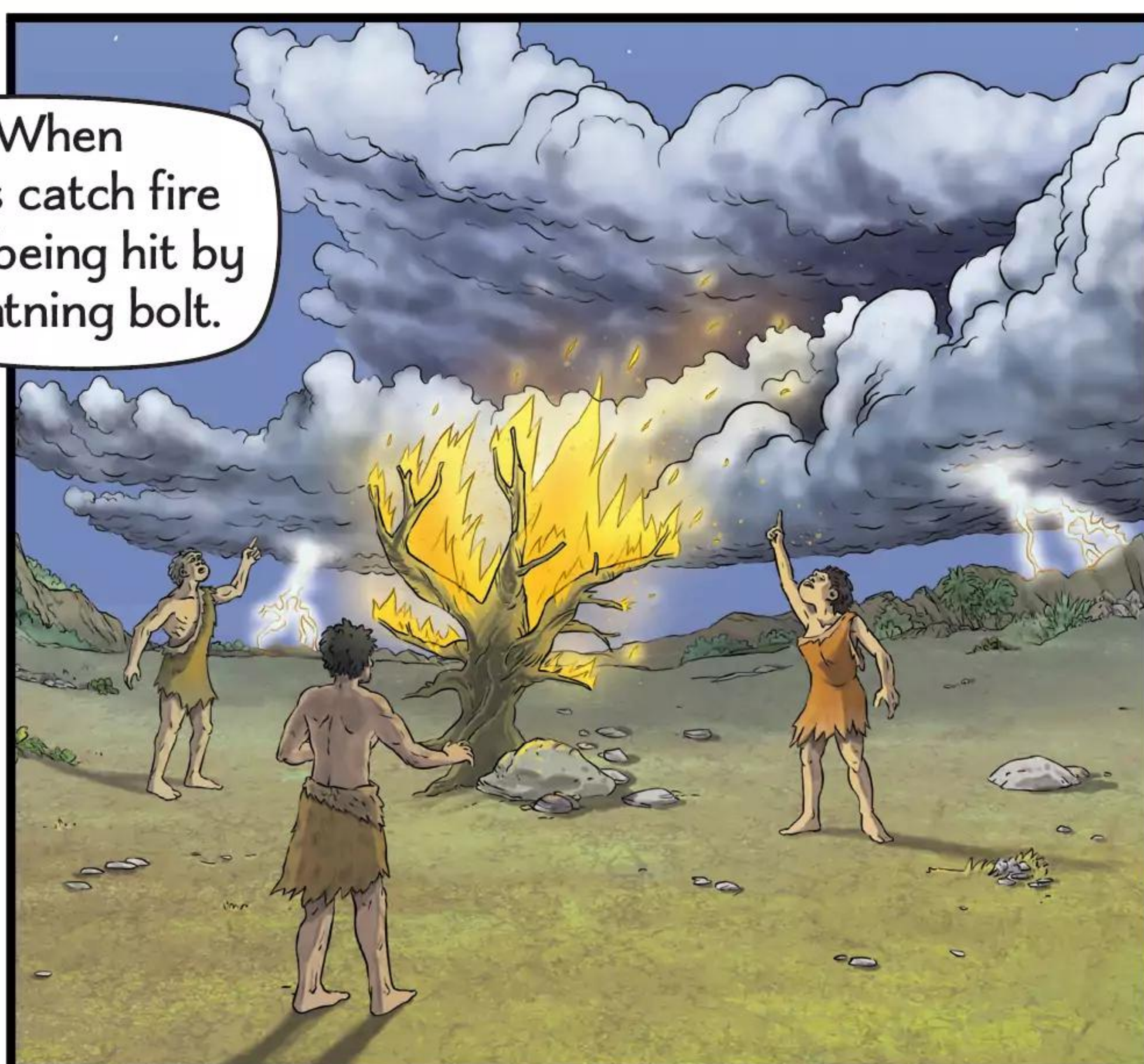
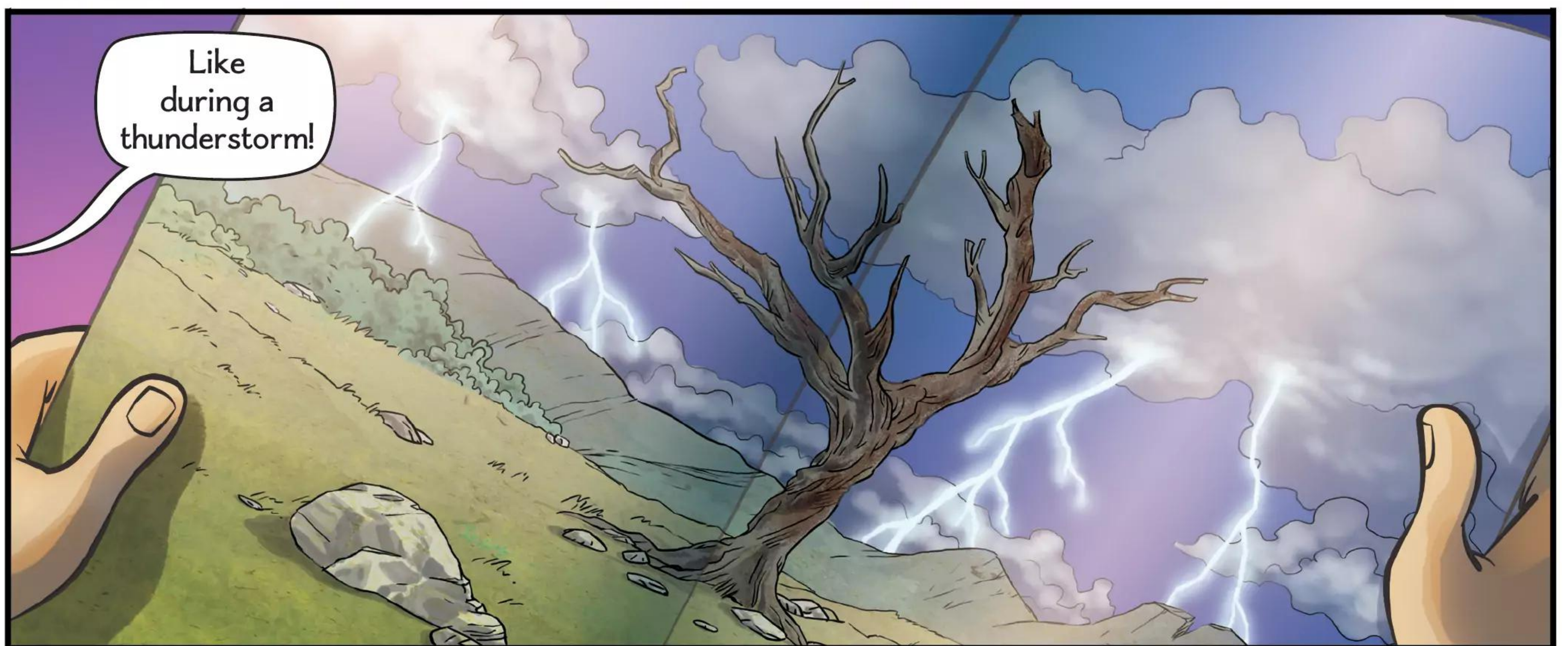


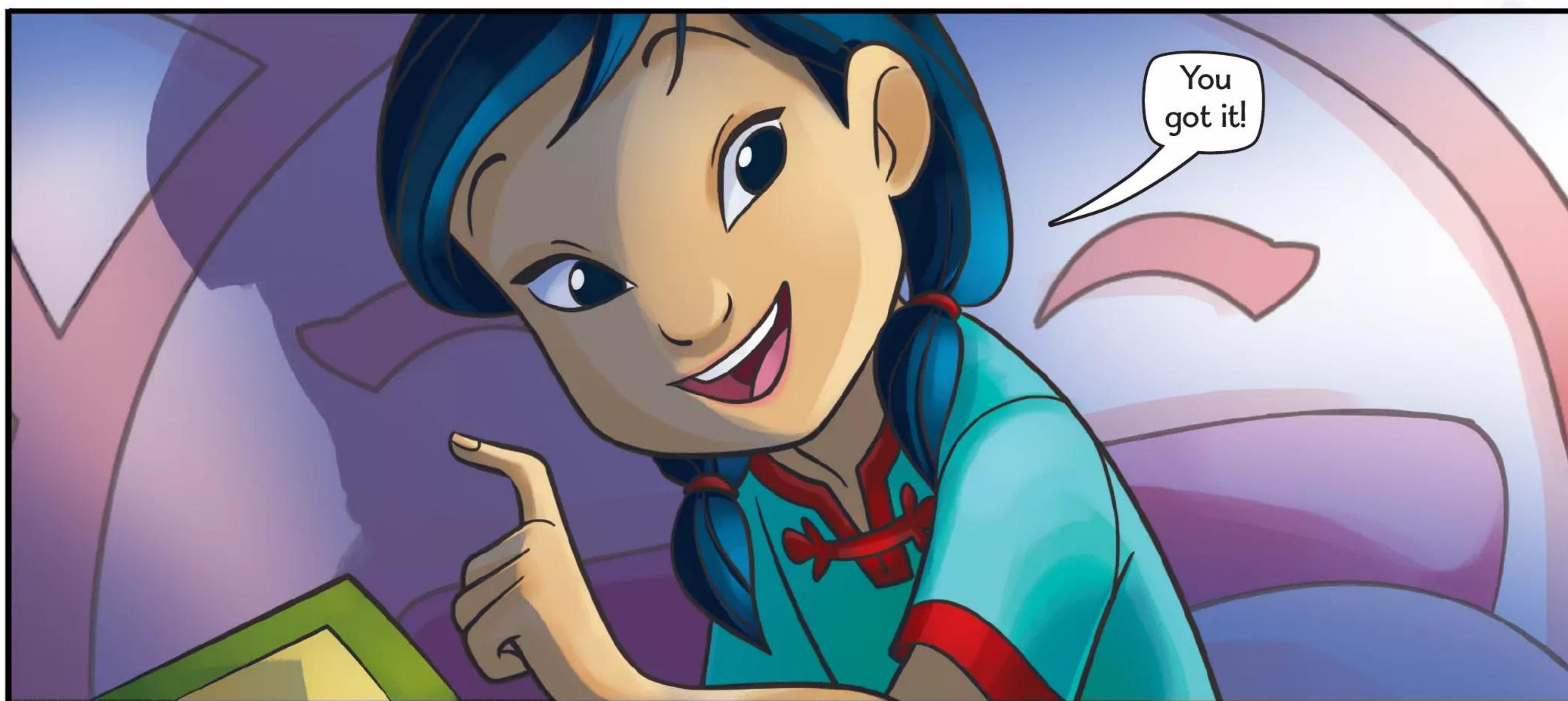




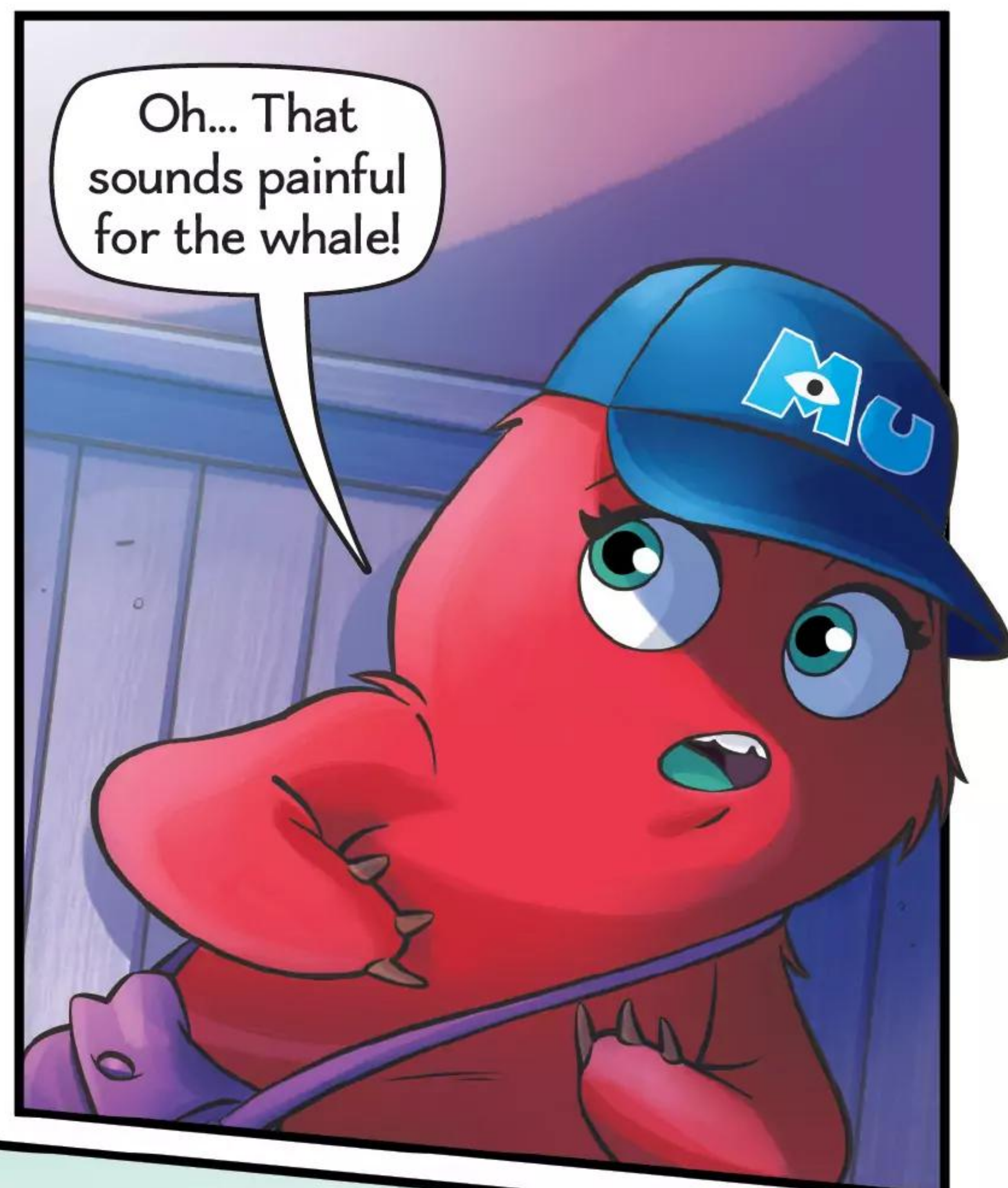
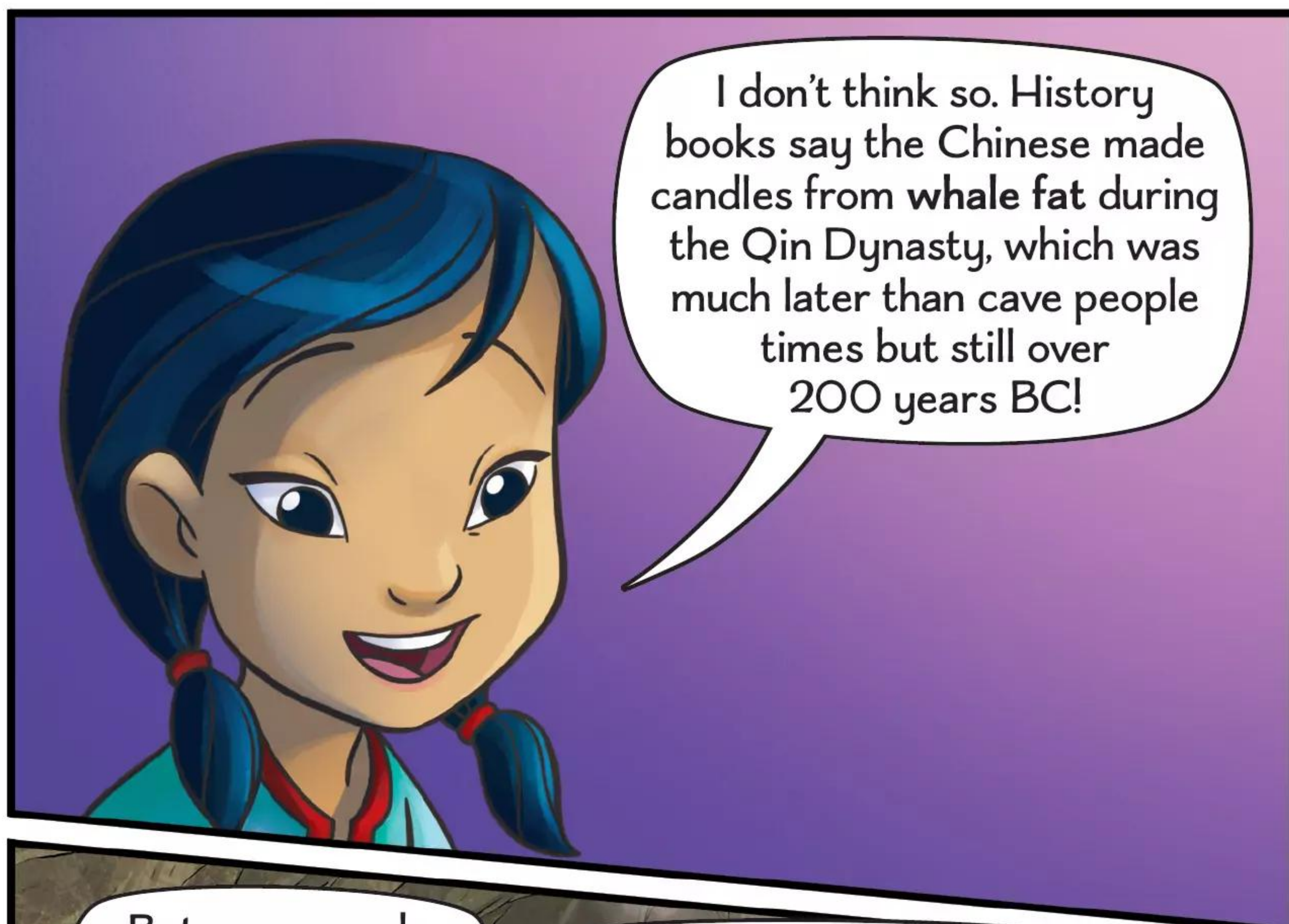












Fascinating!
I can't wait to write
about it in my Human
Studies paper.



Haha, monsters
go to school?!



Lili?



Uh-oh!

Shhhh!
My mom can't
know you're here!
You've got to make
a run for it!





CONTINUES ON PAGE 23

DISCOVERING ENERGY

- It all starts with the sun
- Light and heat
- The importance of fire
- Fire and the secret of metals

It all starts with the sun

THE SUN AND ENERGY

In order to live, grow, and reproduce, all creatures need **energy**, which can **come from different sources**. The main source of energy for our planet Earth is the sun, the star which Earth moves around.

Energy can **take on different forms**. For example, the sun provides energy in the form of **light and heat** by burning at very high temperatures. This process produces rays, which carry that energy to Earth, thus regulating our planet's climate. Sunlight, along with water and

carbon dioxide, a gas present in the atmosphere, nourishes plants, which in turn feed animals and humans. So when we eat, we absorb energy originating from the sun along with our food.

A rule that exists in Nature, and has done since the beginning of time, says that the energy of the whole universe must be conserved. This means that **energy can't be created from anything nor destroyed**, but can only be transformed from one form into another. Hence, the sun's energy-giving rays can be used to produce other forms of energy that are useful for human activities.



Light and heat

THE DISCOVERY OF FIRE

The light and heat from the sun's rays are necessary for life. Primitive humans were quick to realize this, since, like all animals, they had only the sun's heat to warm them. But about two million years ago they made a very important discovery: **fire**.

It probably happened by chance, when primitive humans saw a tree set on fire by lightning or lava from a volcano. They noticed that when fire burns it produces light and heat, just like the sun. This was an important discovery, because at last primitive humans could have light and warm themselves and their caves even when the sun wasn't shining in the sky.

However, primitive humans didn't initially know how to get fire whenever they wanted it. Actually, it took them about one million years! They discovered that taking a type of stone, called **flint**, and banging



it against another stone containing iron **created sparks**. They could also make sparks by rubbing a pointed stick very quickly against a piece of hard wood. Then they let the sparks fall onto a pile of straw or dry leaves, which finally caught on fire.

↓ Once they learned how to light a fire by themselves, primitive humans no longer had to wait for lightning or go near a volcano to get it.



FUELS

Once fire had been lit, it was important to keep it burning. In order to do so, primitive humans—as we do now—needed fuel, a material that burns easily. The most common one was **wood from trees**, which could be easily found in nature.

Another fuel they used at that time was animal dung. The dung was kneaded and pressed into little bricks that were easy to carry, and then dried in the sun. When used, the bricks burned slowly and produced even more heat than wood.



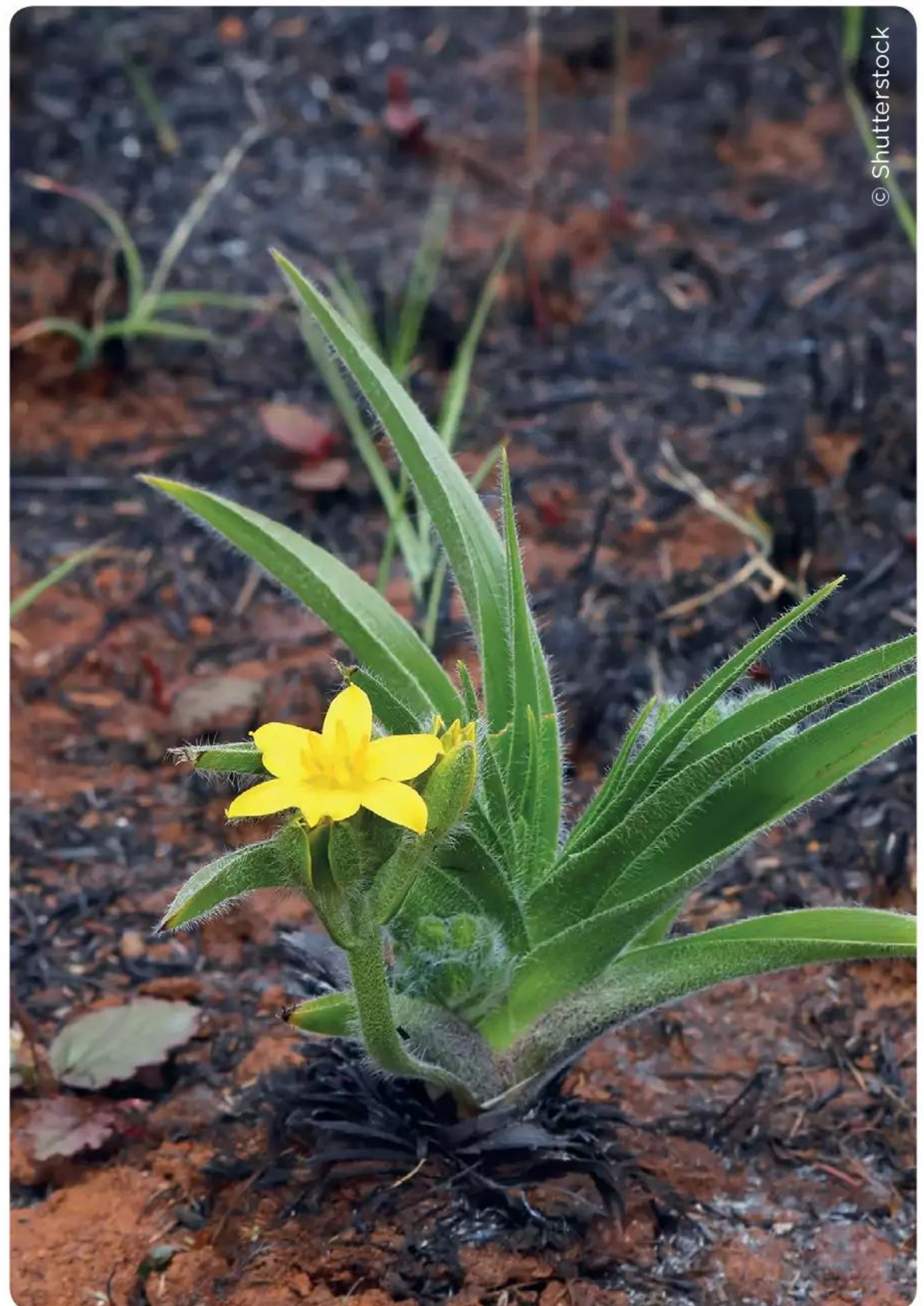
↑ In order to transport fire, primitive humans made the first torches by tying together branches rich in resin. Later they invented lanterns that burned oil, and lastly candles.

The importance of fire

COOKING FOOD

Primitive humans used fire to keep themselves warm and to **create light around them** at night or in the caves where they lived, but they also used it for protection. Fire, in fact, kept wild animals away. Humans also discovered that cooking food on the fire would make it softer, tastier, and easier to digest. So their **diet**, and therefore their health, **improved**.

Ancient humans' diet consisted of meat from the animals they hunted as well as plants and berries they found in nature. In 2020, during excavations in the Lebombo Mountains, between South Africa and Eswatini, archaeologists found the remains of some plants. They were part of one of the oldest cooked dinners in the world: they dated back to 170,000 years ago!



↑ *Hypoxis angustifolia*, a plant with a typical yellow flower. Its shoots were hard and stringy when raw but easier to digest if cooked.

Fire and the secret of metals

THE ORIGIN OF METALLURGY

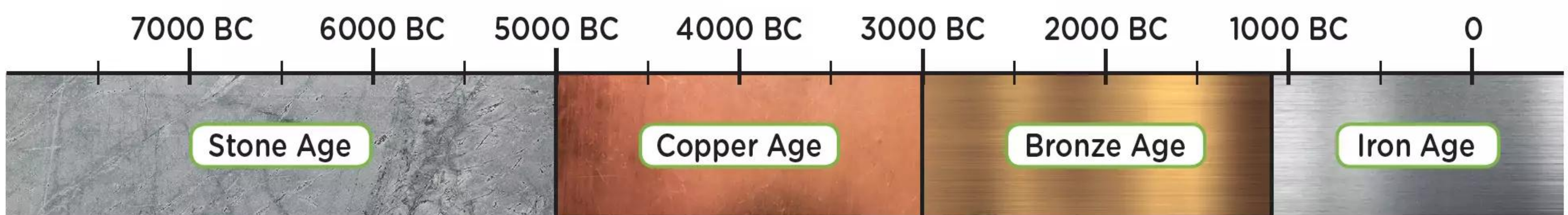
Toward the end of the **Stone Age**, primitive humans noticed a strange phenomenon: when certain types of rocks were close to the fire, the heat made them red-hot, and a shiny gray liquid (tin) or a reddish one (copper) was released. These were **metals**, materials still used today. At high temperatures they **turn to liquid** and then, when they cool down, they **solidify again**.

Over time, humans learned that they could use these metals to make objects, like tools and weapons, by giving them certain shapes while



↑ Iron wasn't melted but heated with coal and then hammered into shape.

liquid and then letting them solidify. This prehistoric period is called the **Copper Age** and marks the origin of **metallurgy**, the art of working metals.



➔ Researchers have named the various prehistoric periods after the materials primitive humans used the most for their tools.



Later, humans mixed together tin and copper, creating a new material, bronze, which was harder and more durable. Better tools and weapons could be forged from it, such as swords, spearheads, and arrows. This period is called the **Bronze Age**.

In the following period, the **Iron Age**, metallurgy became more widespread, thanks to iron. This metal is easy to find in nature, usually in rocks such as hematite and magnetite, and was already known. But until better furnaces were invented, it was rarely used, as it needs a much hotter fire than bronze does to be able to extract it and shape it.

FULL STEAM AHEAD!

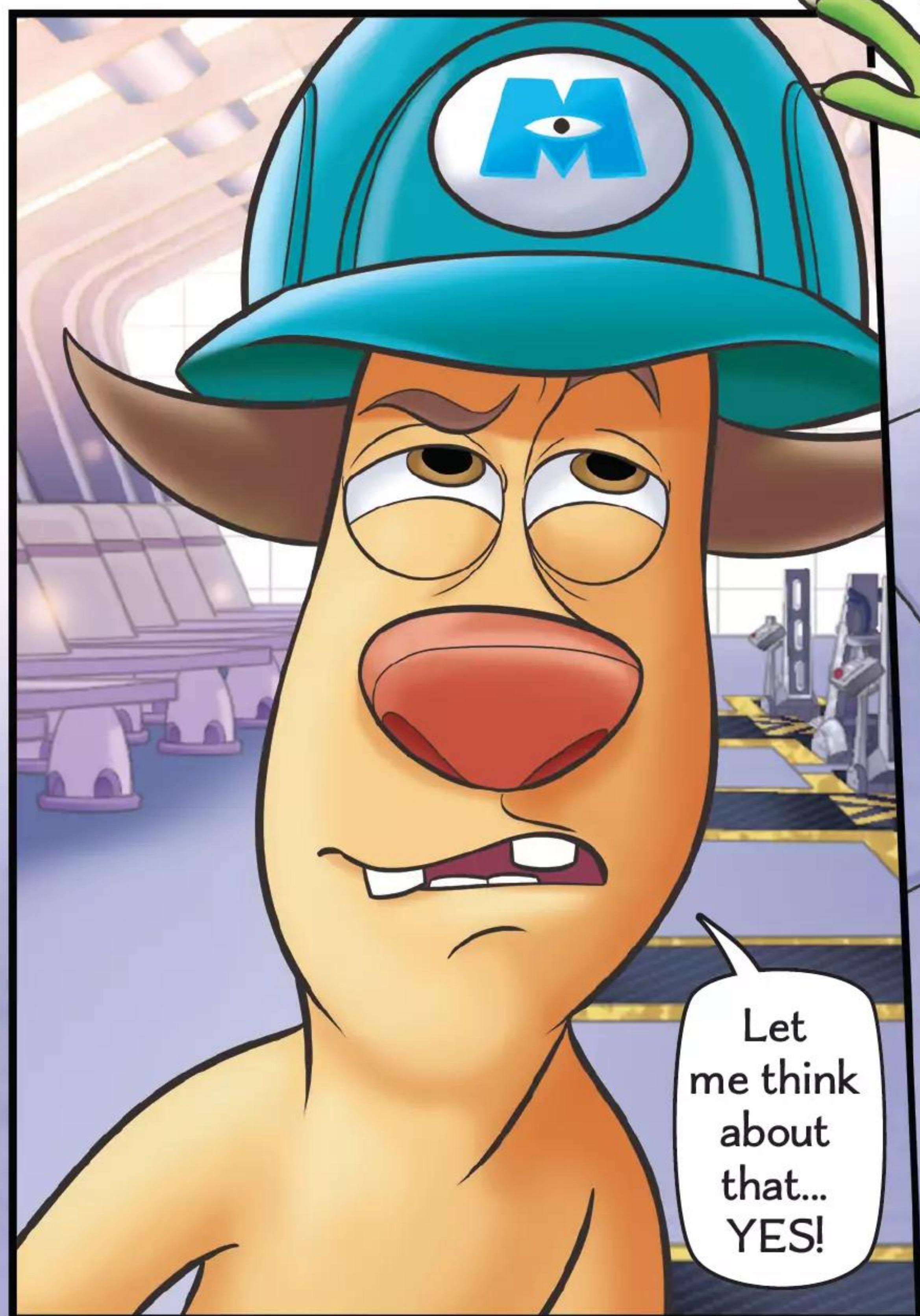
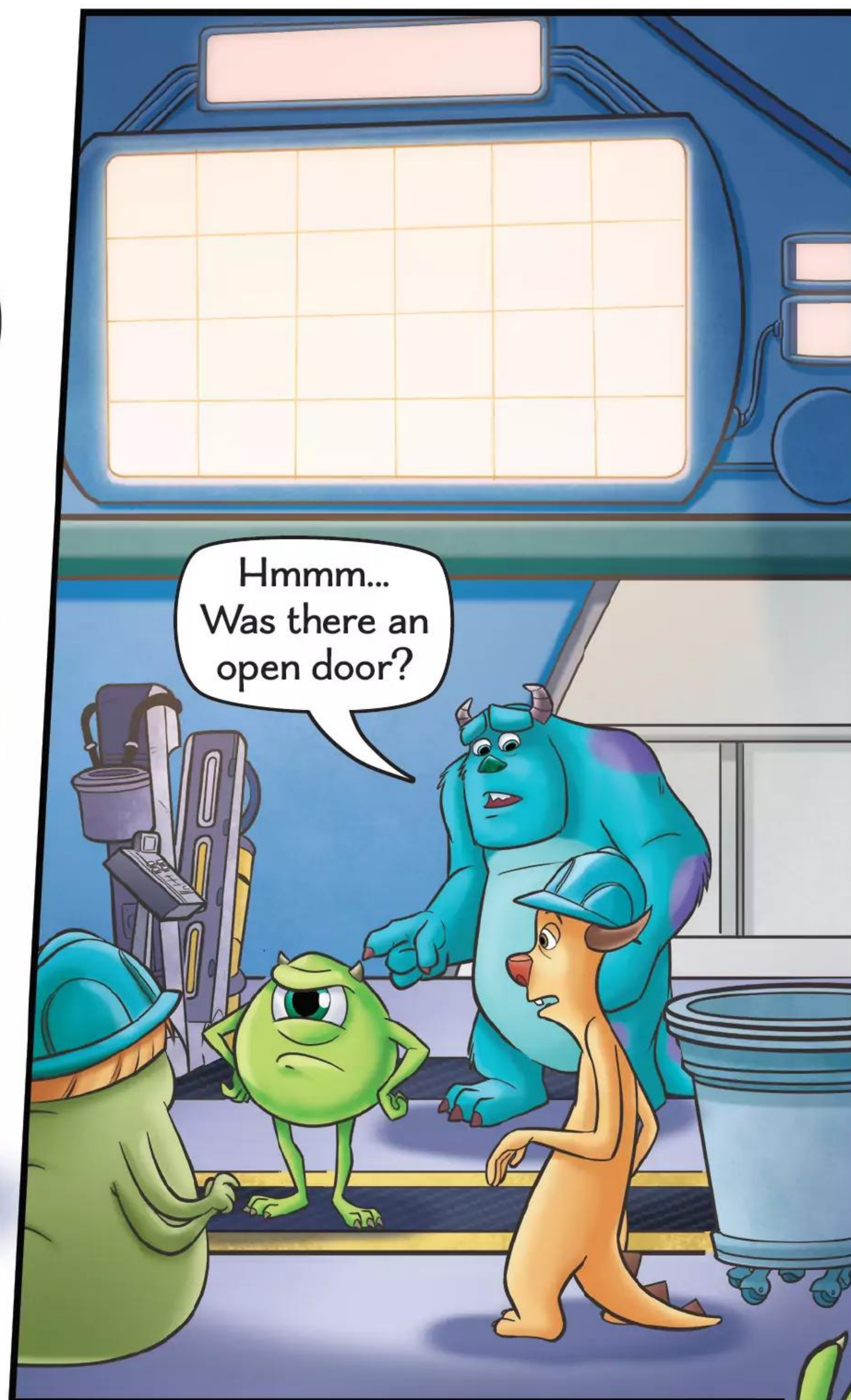
During the break,
at the cafeteria...

Hey, Googly
Bear, I've just done
a count and we seem
to be one monster
kid short.

What?!







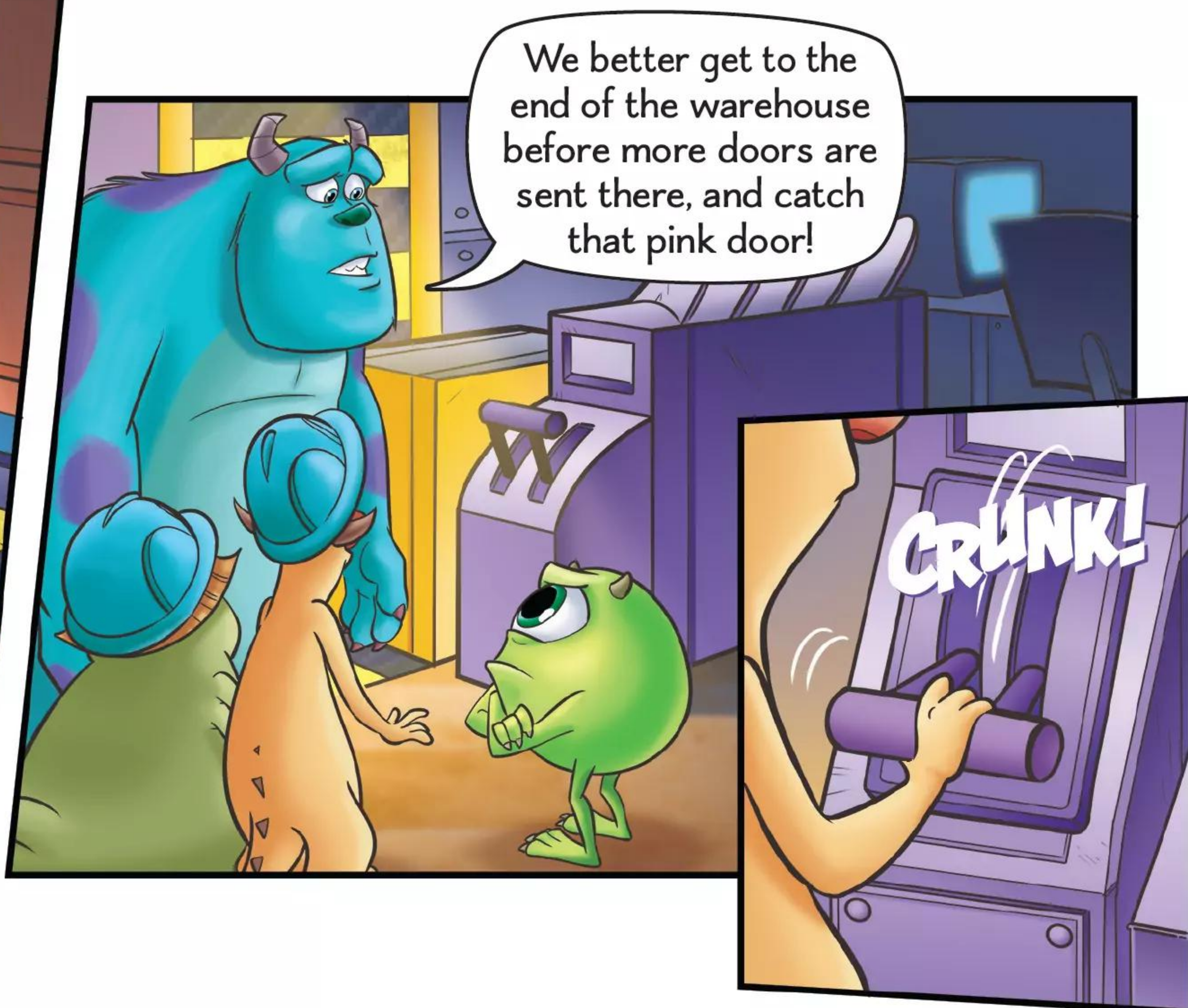


A little later in the door warehouse...

So, if we pull this lever, you guys say we can activate 'ON mode' on all the doors?

Yep!

But this warehouse has hundreds of thousands of doors!



All the doors in the warehouse
become active...



Wow! On the
Laugh Floor they said
the red light means
you can go through
the door...

This is the perfect
opportunity for me to find out
the truth about human energy
for my Human Studies paper!
Here I go!



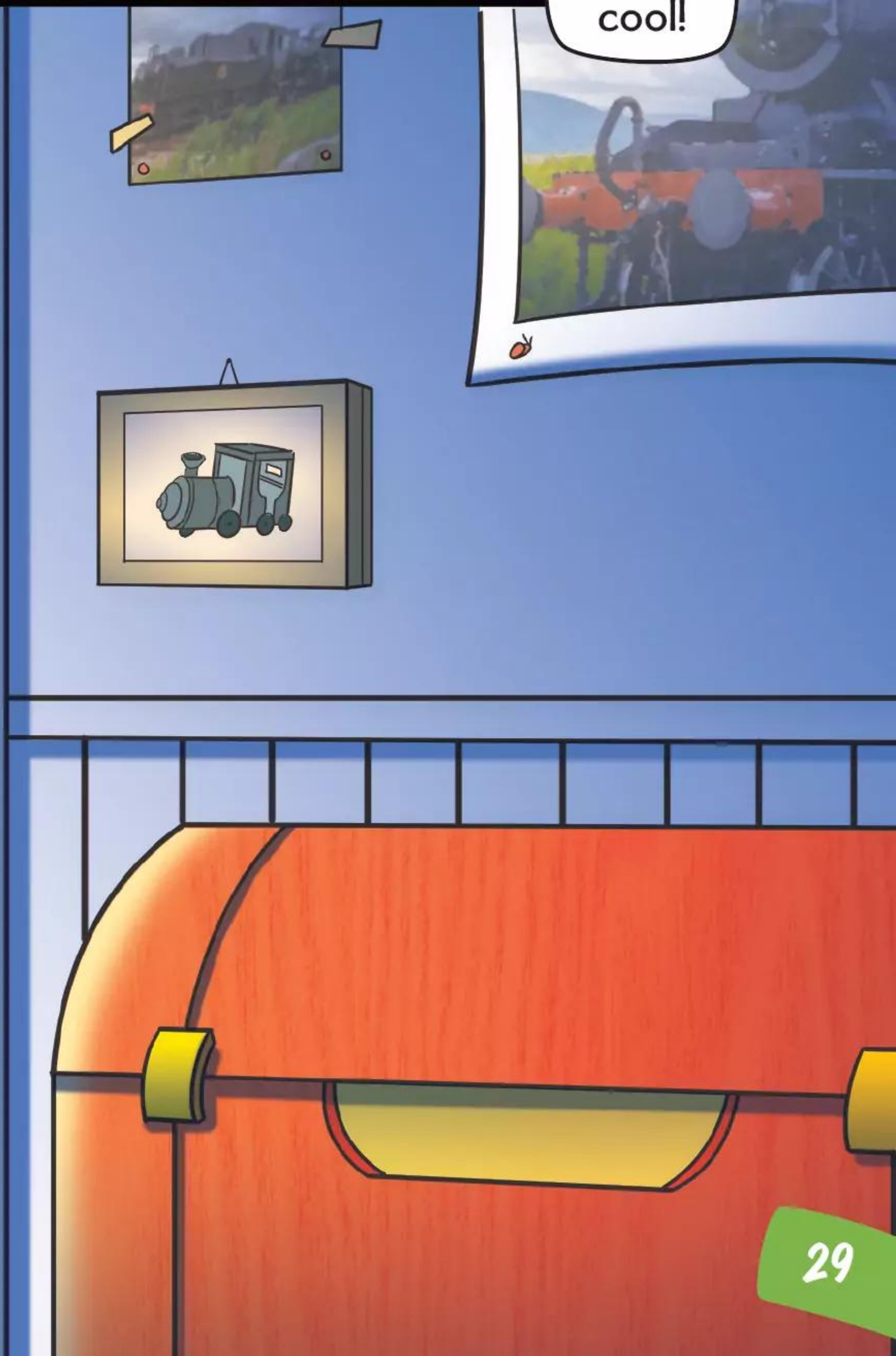


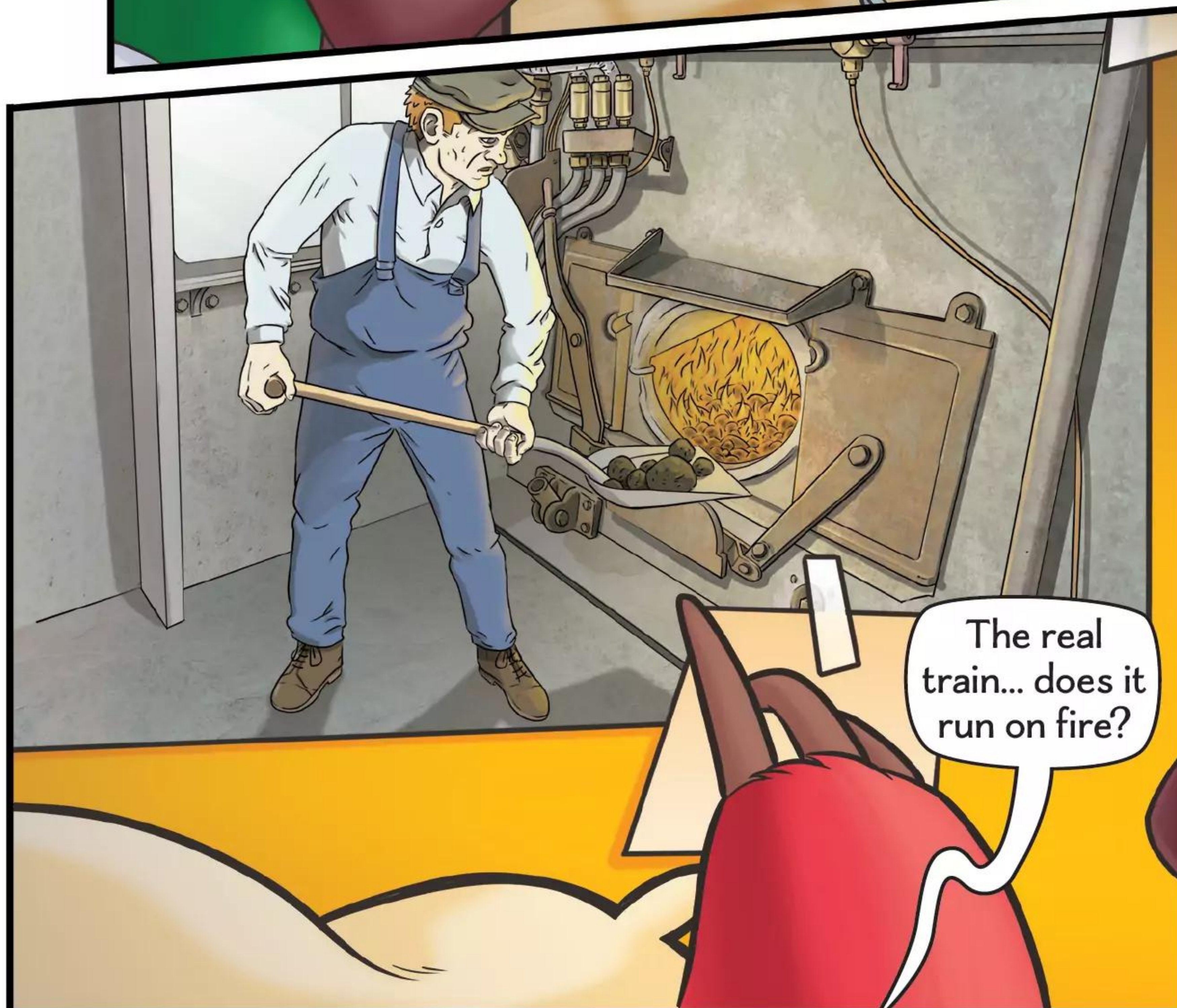
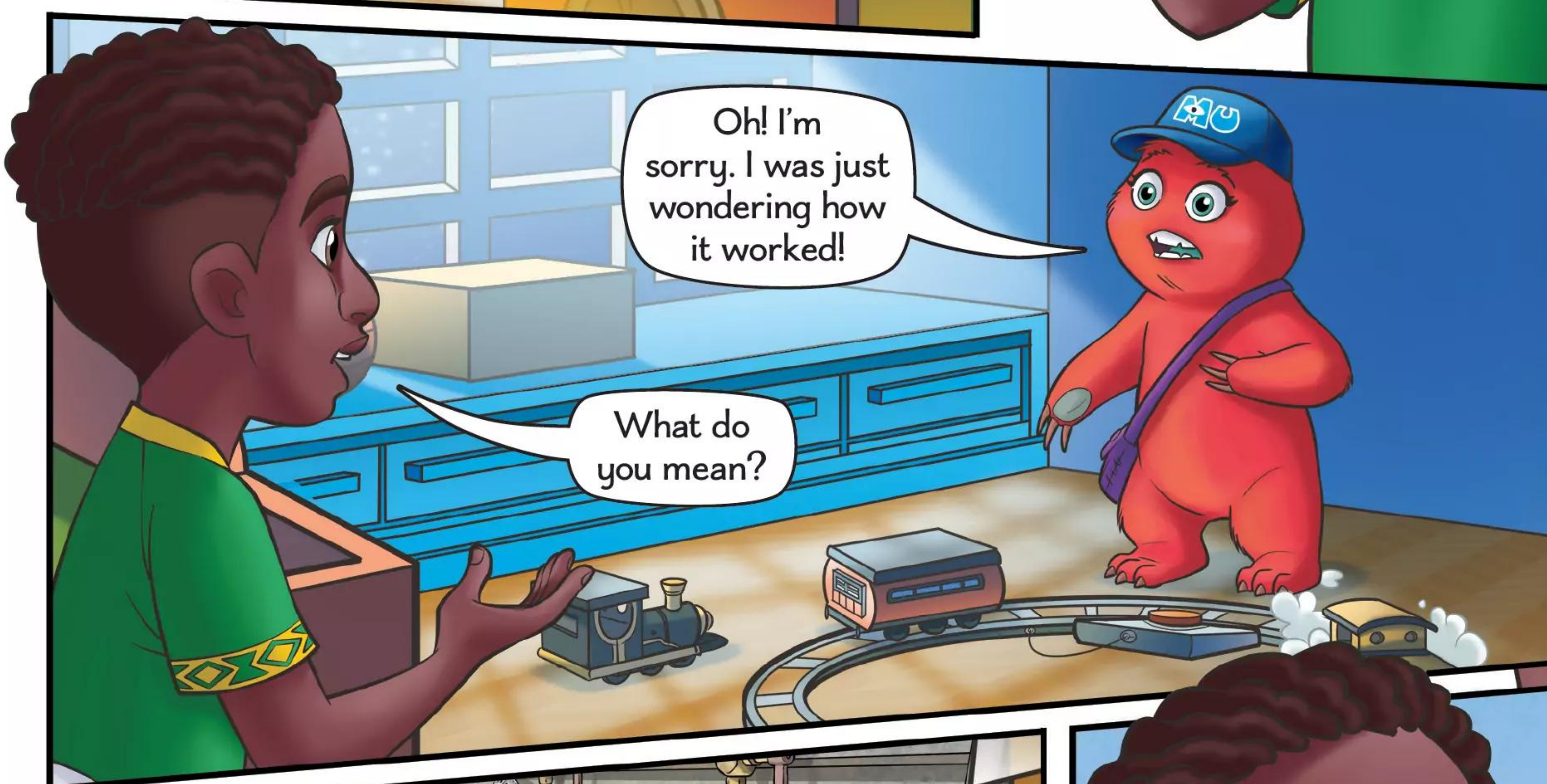


Wow,
cool!



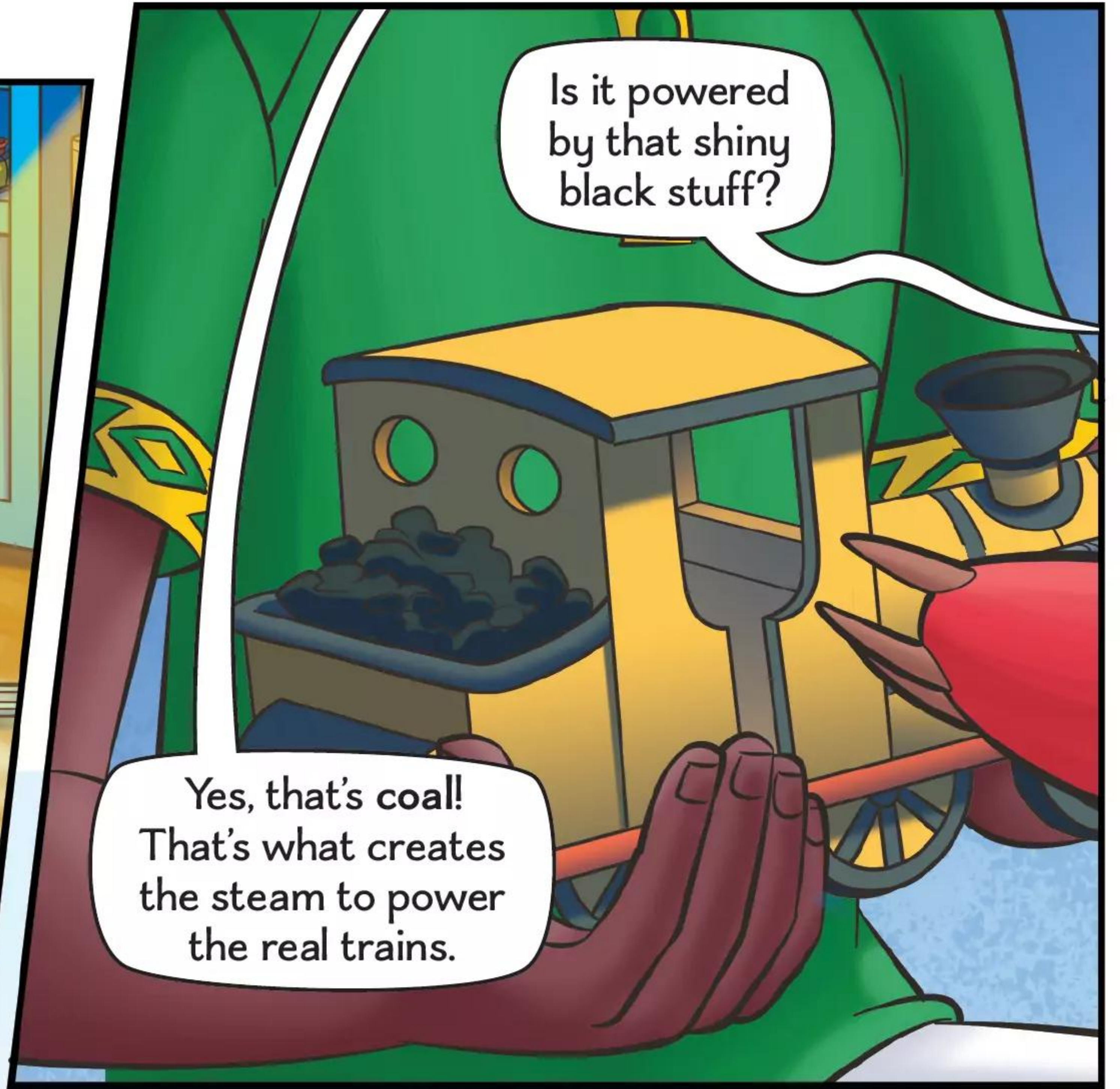
Huh, are you
a monster?!







Steam trains were invented over 200 years ago, and I know *all* about them.

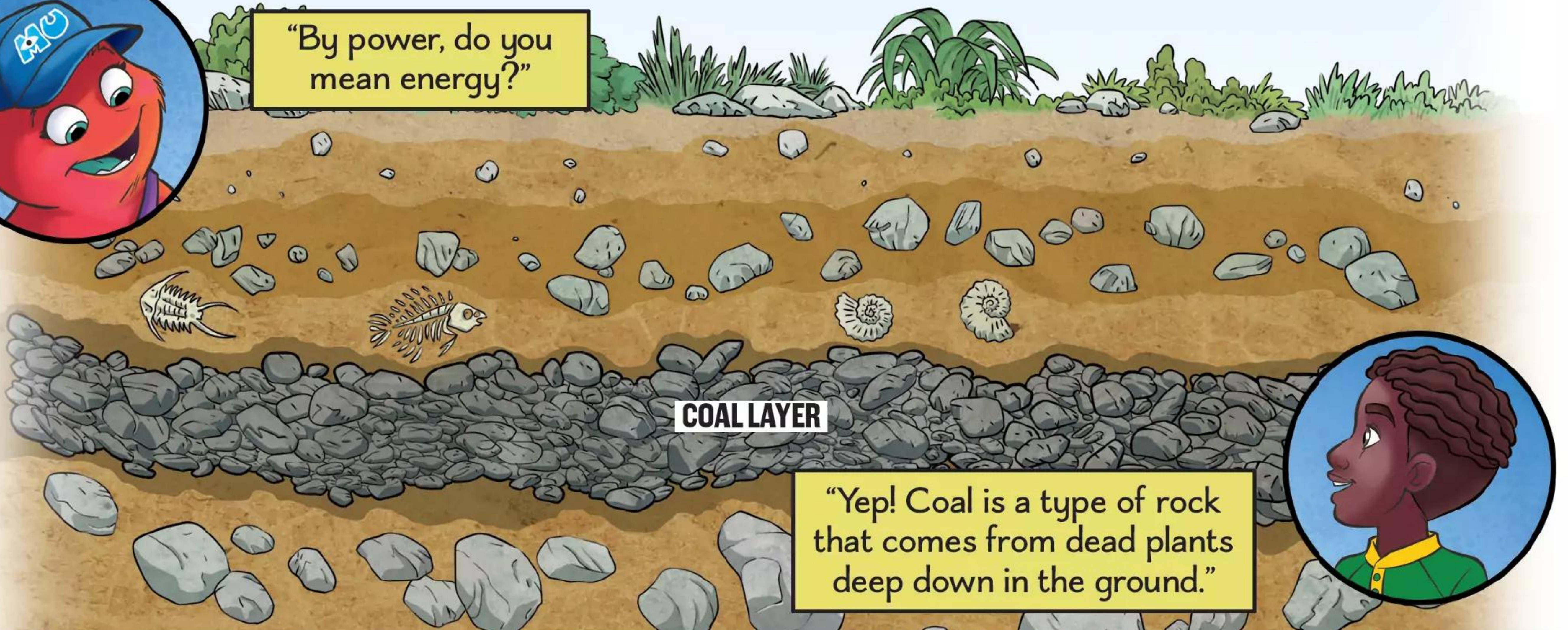


Is it powered by that shiny black stuff?

Yes, that's coal! That's what creates the steam to power the real trains.



"By power, do you mean energy?"



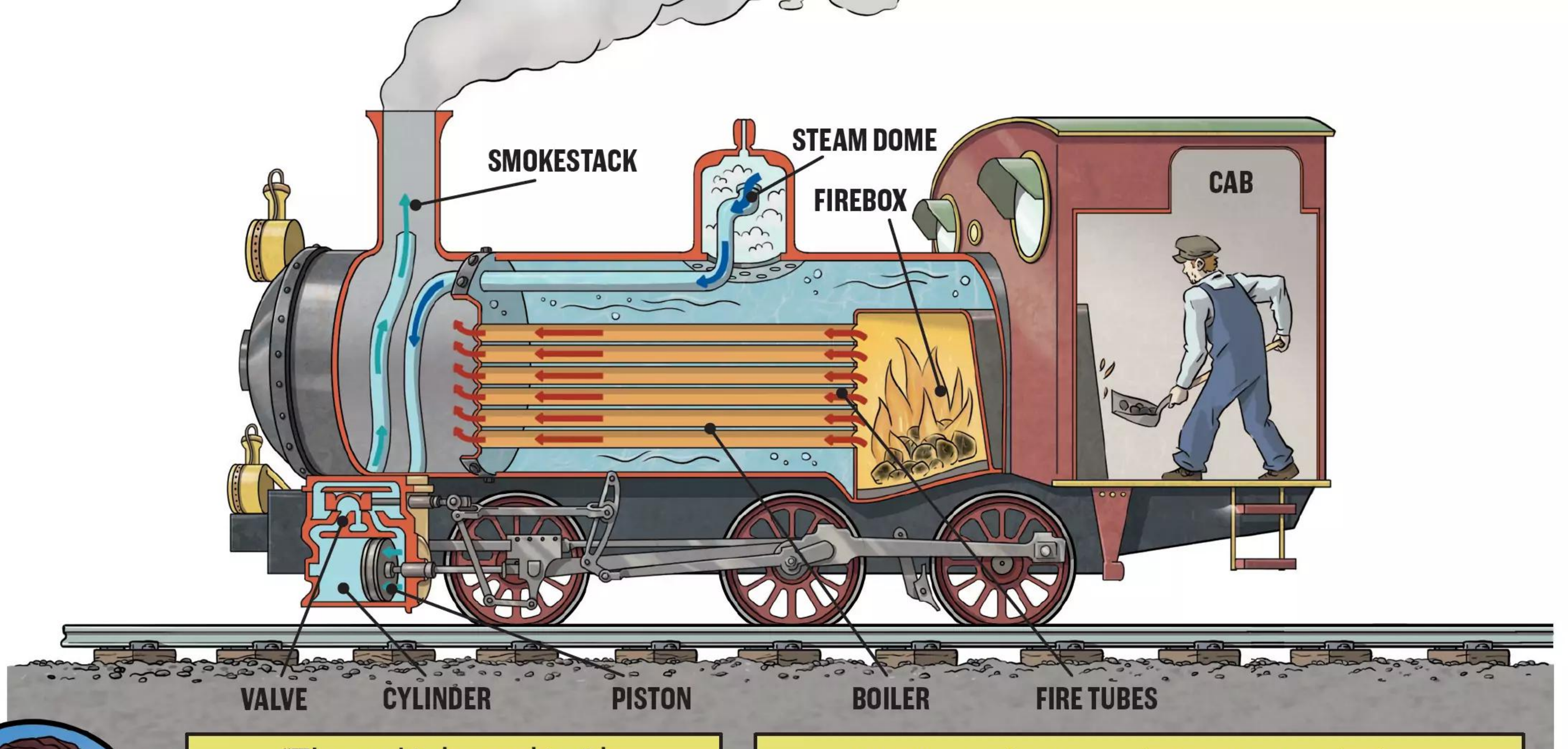
COAL LAYER

"Yep! Coal is a type of rock that comes from dead plants deep down in the ground."



But how does it create the steam, then?

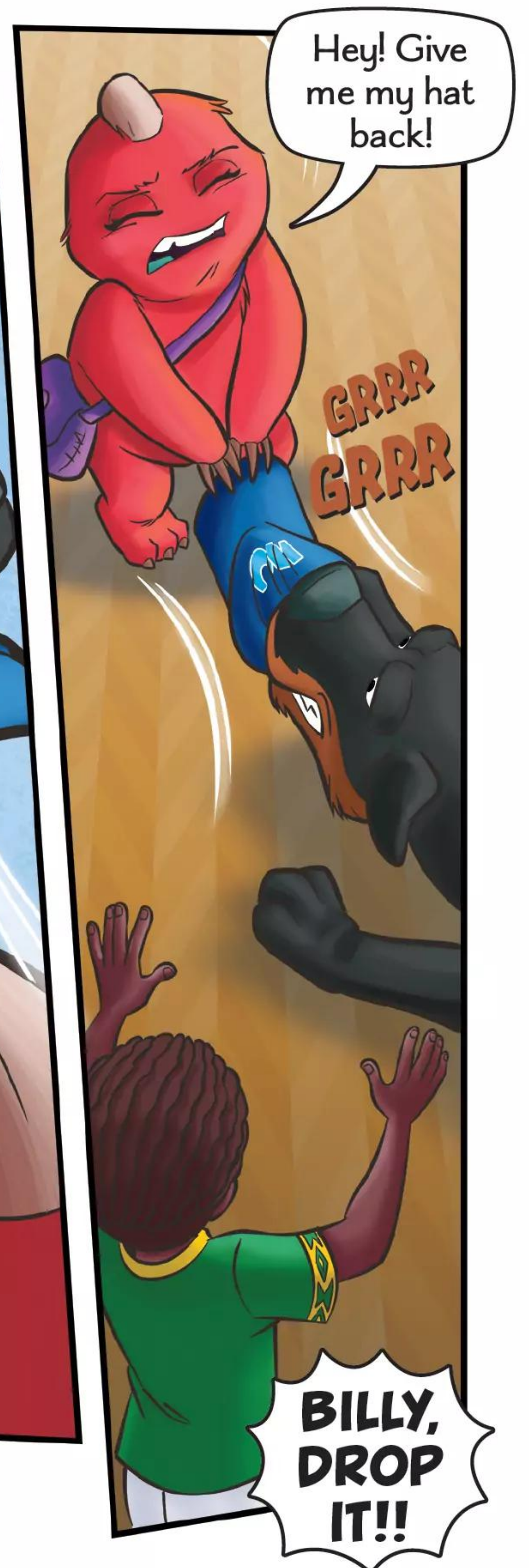
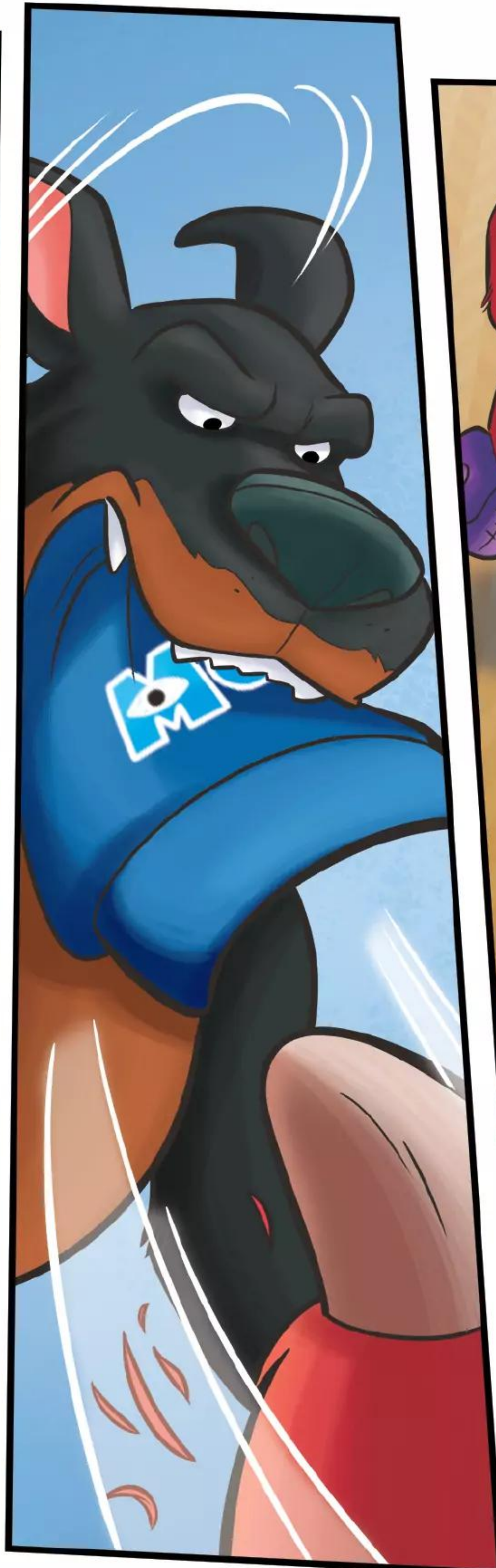
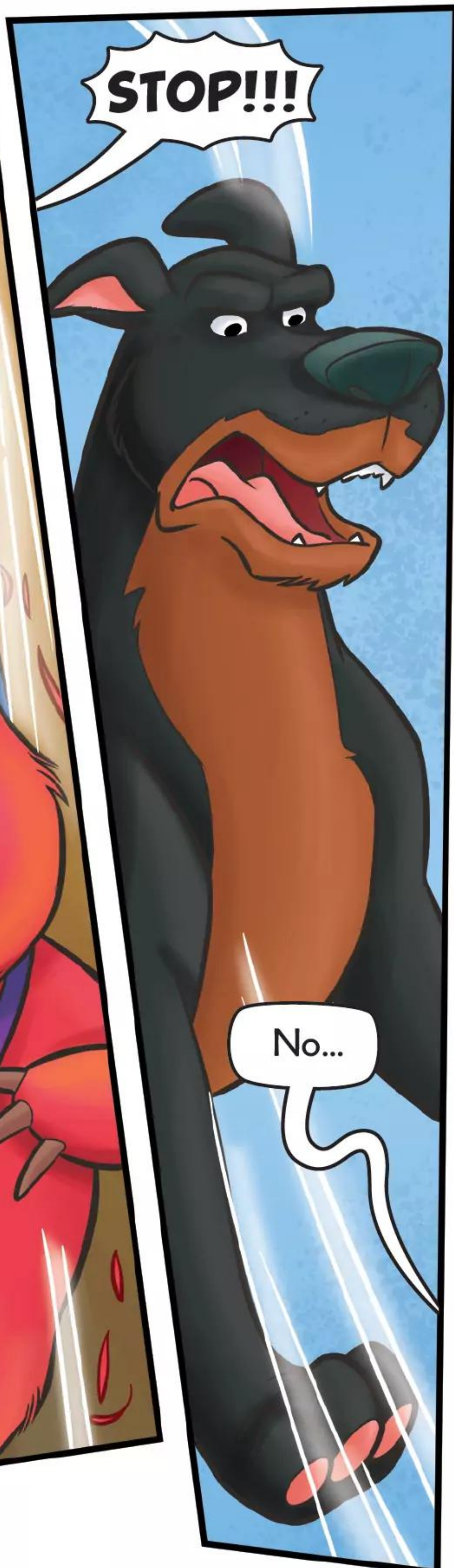
Well, look at that poster on my wall!



"The coal is burned inside the firebox, which is like an oven within the train's engine, with lots of fire tubes. This is what heats up the water inside the boiler compartment, which turns into steam..."

"As it gets hotter and steamier inside the boiler, the pressure rises, pushing the steam up to the steam dome. It then travels down the valves to the cylinder's pistons, which are connected to the driving wheels and make the train move..."







CONTINUES ON PAGE 39

NONRENEWABLE ENERGY

- Where coal comes from
- The popularity of coal
- The Industrial Revolution
- From steam to electricity



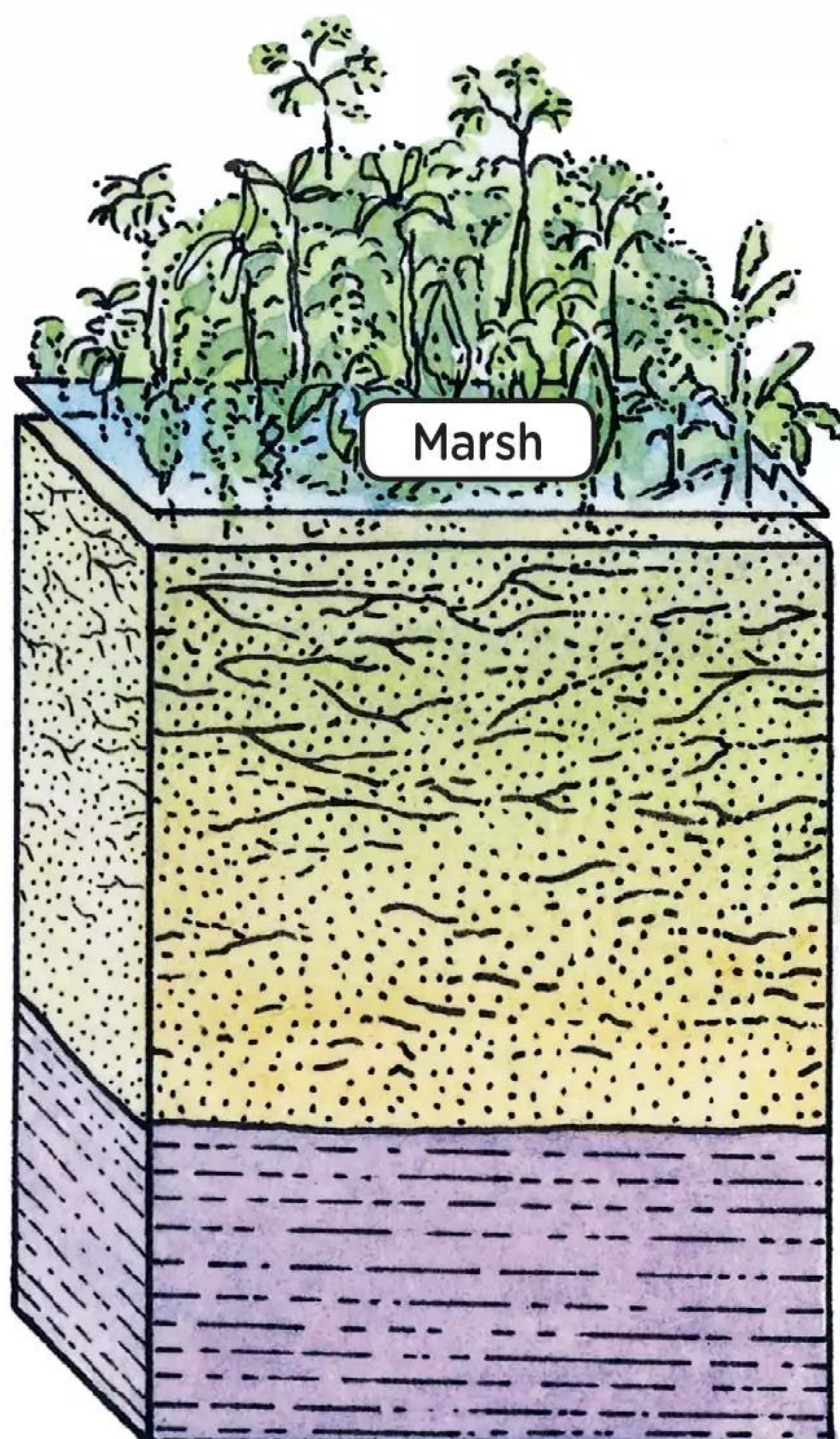
Where coal comes from

VERY ANCIENT ORIGINS

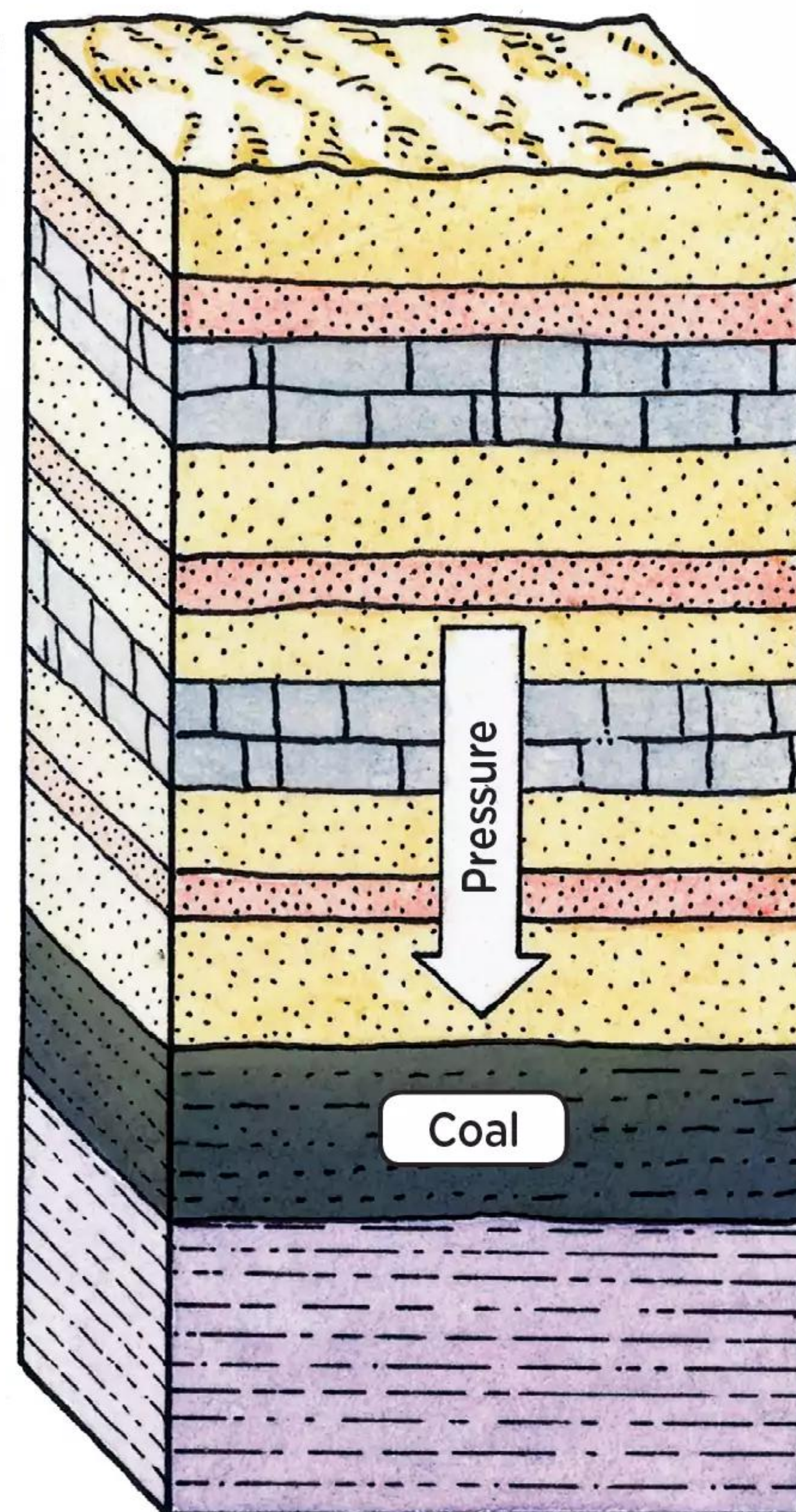
For hundreds of thousands of years, wood from trees was the main fuel used to keep fires burning. About 3,000 years ago, however, primitive humans discovered that another type of fuel existed in nature: **coal**.

Coal formed during the **Carboniferous Period**, around 300 to 350 million years ago. In coastal and marshy areas, plants and trees were periodically submerged by water. Their remains accumulated on the seabed or in the marshes, under a layer

of mud and sand. The weight of this layer triggered a process called **mineralization**, which transformed the remains of dead plants into coal. This process still occurs today, but it takes **millions of years** to complete.



© Science Photo Library



During the Carboniferous, heat and humidity made many plants grow. Earthquakes then buried the plants under layers of rocks and earth, crushing them until they became coal.

The popularity of coal

FOSSIL FUELS

As well as coal, **oil** and **natural gas** are also created by mineralization. However, oil is the result of this process on prehistoric animal remains, while natural gas can originate from both animal or plant remains. Coal, oil, and natural gas are all called **fossil fuels** because they derive from the remains of living creatures from many years ago. Today humans are using such huge amounts of fossil fuels that there is a risk **they will run out of them in just a few decades**, as it takes millions of years for new coal, oil, and natural



During the Bronze Age, primitive humans used only the coal they found on the earth's surface.

gas to form. As such, fossil fuels are known as **nonrenewable energy** sources, meaning they can't be restocked in a short space of time.

THE IMPORTANCE OF COAL

Coal is very useful as a fuel because when it burns, it produces a lot of heat and it lasts longer than wood. It is also lighter and easier to transport. However, it is almost always found underground: you need to know where to dig in order to get it! That's why humans initially used wood more. Then, in the **18th century**, coal became more important with the

invention of **steam engines**. Activities people were used to carrying out by hand, and at a slow pace, such as weaving, could be done much faster with steam-powered machines. However, a lot of fuel was needed to make the engines work and wood wasn't enough, anymore. So, people started using more coal.

Since the end of the 18th century, deep tunnels called mines have been dug in order to extract coal underground.



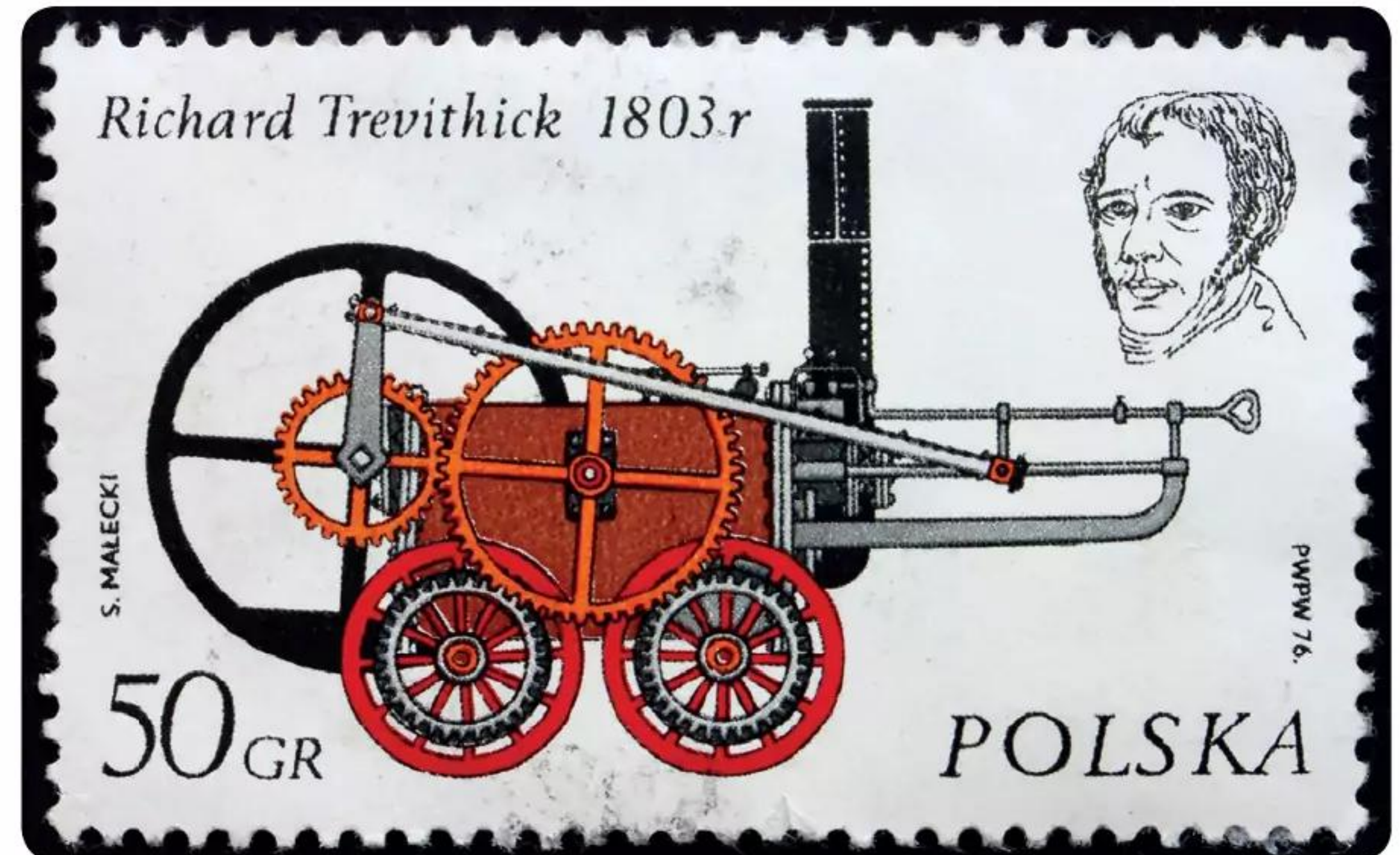
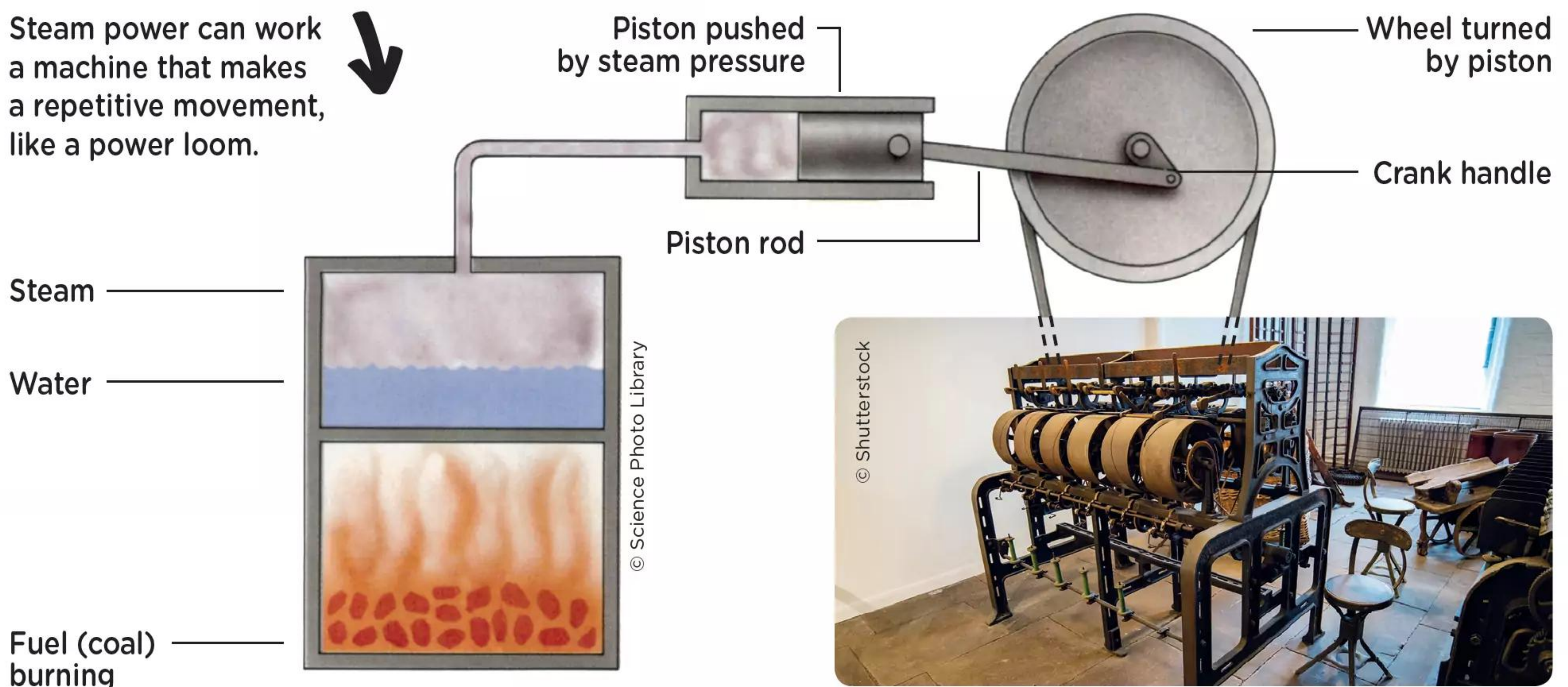
The Industrial Revolution

STEAM ENGINES

The machines that scientists were able to design thanks to the invention of steam engines solved a problem that people faced during the 18th century. The population had greatly increased, especially in England but also in the rest of the world. This meant that more everyday items were needed, starting with clothes. New steam engine machines such as **power looms** allowed weavers to make more clothes in less time. That's how the first industries began, and this period became known as the **Industrial Revolution**.

Operating the machines required a great amount of energy, which was produced by steam. A large quantity of water was poured in a closed container, and then it was heated by fire, causing the water to boil and turn into steam. The steam expanded and pressed against the walls of the container hard enough to move a **piston**. Then, using cranks

Steam power can work a machine that makes a repetitive movement, like a power loom.



In 1803, the British engineer Richard Trevithick built a steam engine on a cart for transporting coal in the mines. That's how the first steam train was invented!

or gears, the piston could move a wheel or a mechanical arm that went backward and forward, like the one in a loom. The steam engine, invented in England by **Thomas Savery** in 1698 and **Thomas Newcomen** in 1712, and later perfected first by Newcomen and then by **James Watt**, was used to extract water from the subsoil, preventing the mines from flooding. Later, steam was also used to move vehicles, and in 1769 French engineer **Nicolas-Joseph Cugnot** put a steam engine on a three-wheeled cart, building the ancestor of cars.



From steam to electricity

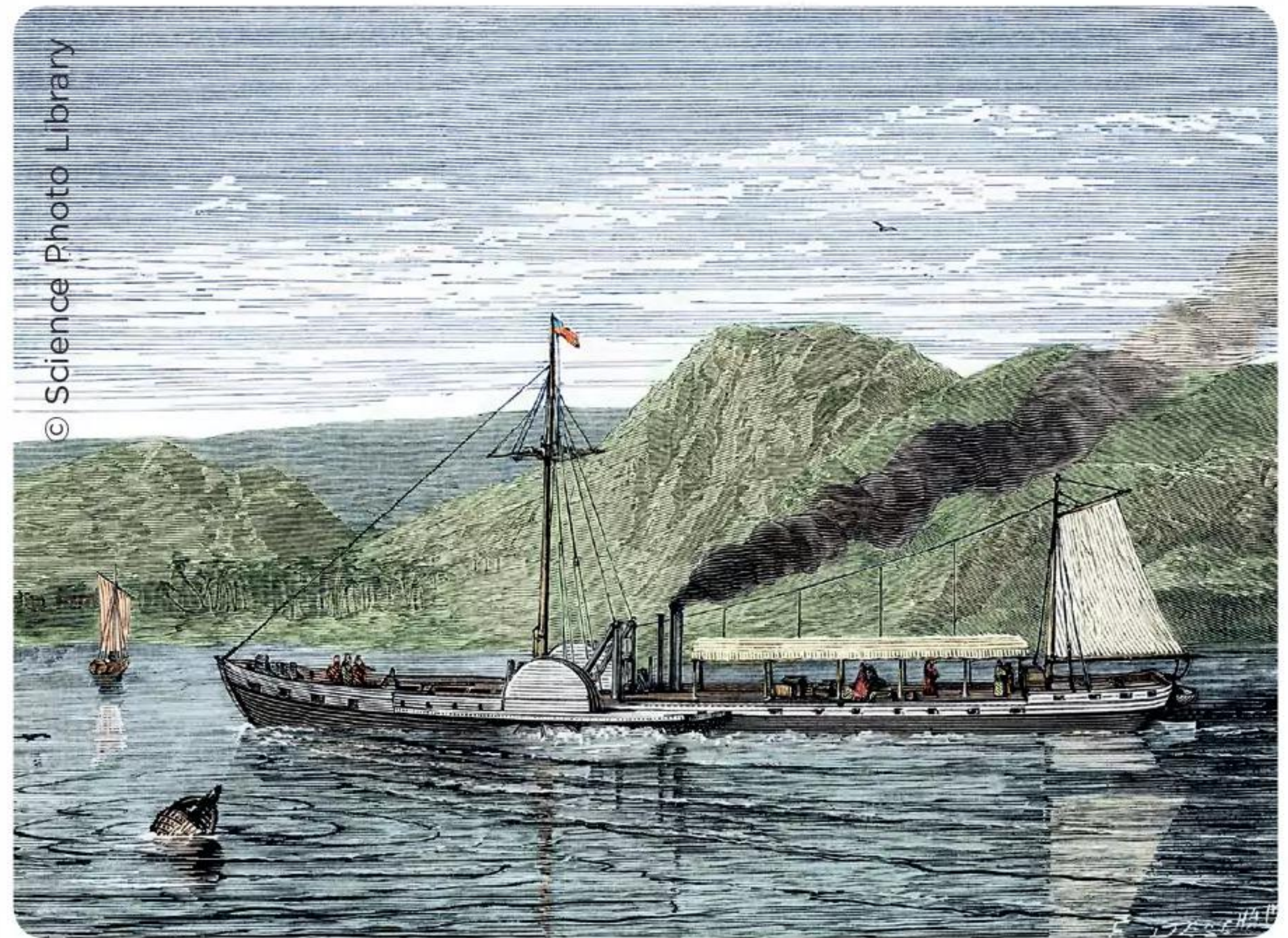
ELECTRIC ENERGY

With steam vehicles for transport, people could travel around the world more easily. It was a great **transport revolution**. More goods and raw materials could also be moved with less effort, leading to huge developments in trade.

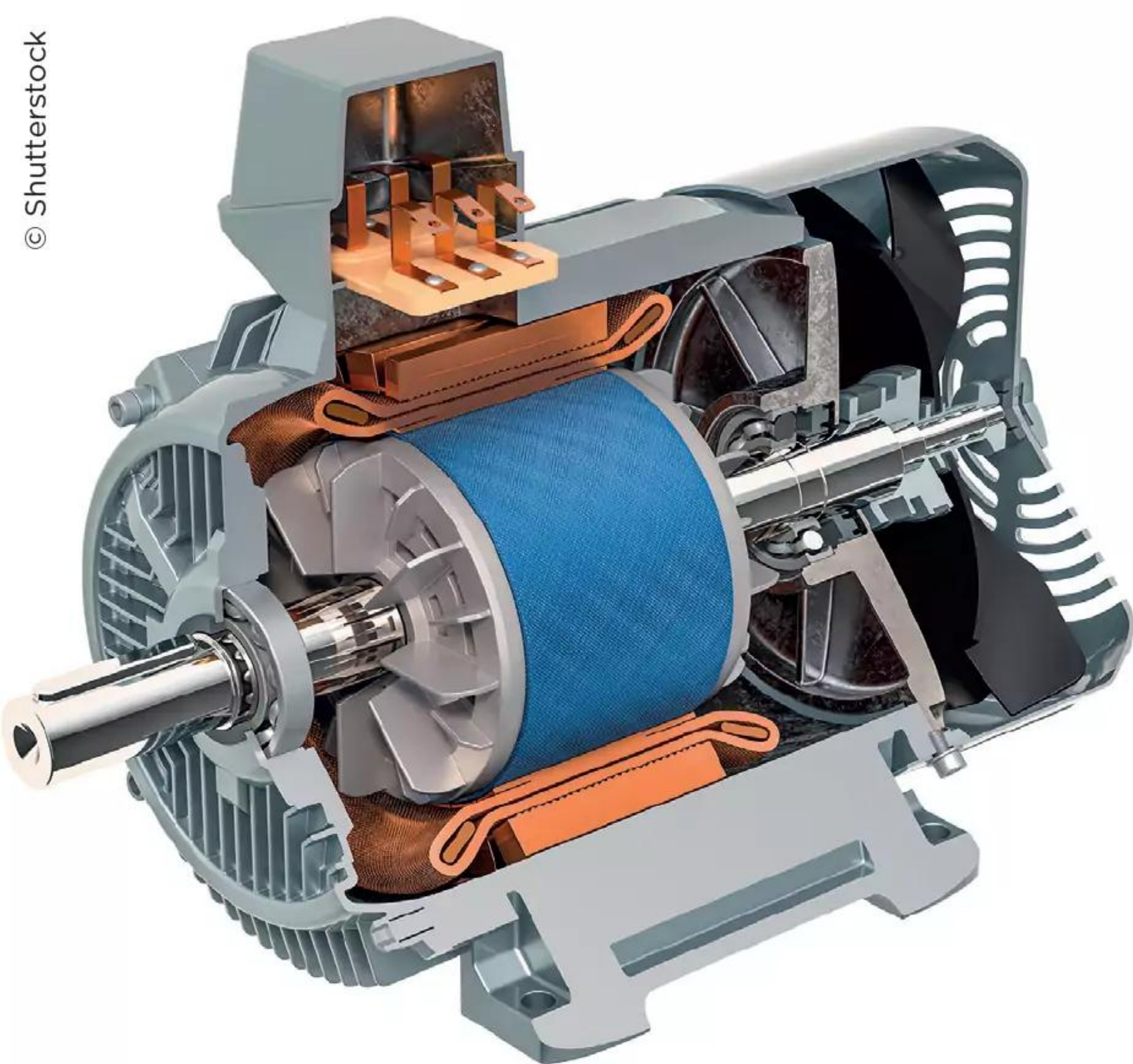
But steam was also crucial for another reason. Before, and immediately after the invention of the **electric motor** by British scientist **Michael Faraday** in 1821, steam-powered machines were often used to produce electricity. In this case, the steam drove a **dynamo**—a device that transformed movement, or mechanical energy, into electricity. The way we obtain energy through steam is an example of **energy transformation**: the sun makes plants grow, plants become coal, people use

coal as a fuel to heat water, and this creates steam, which finally is used to produce electricity.

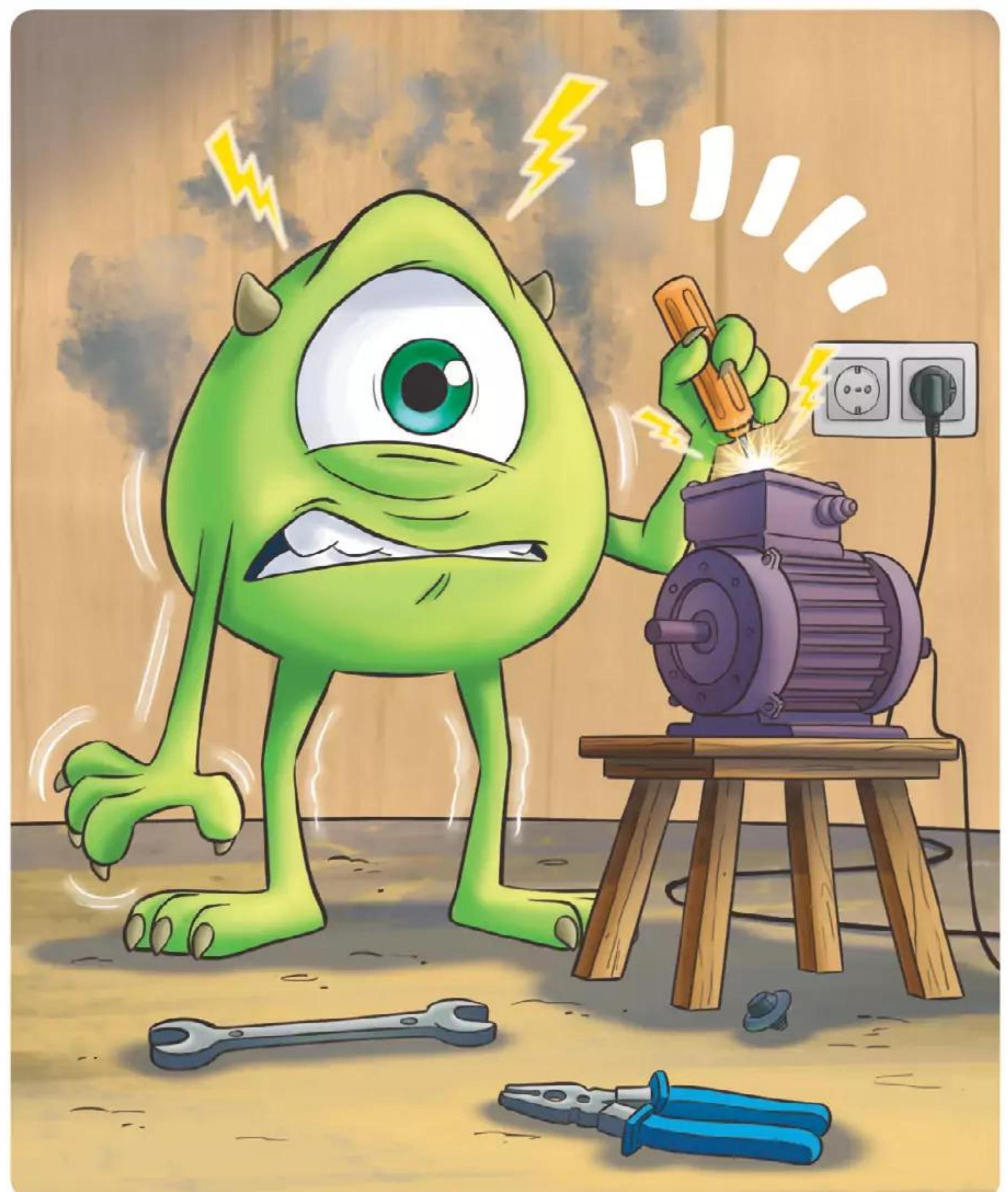
From 1840, steam-powered machines were replaced by electric motors that evolved from Faraday's revolutionary invention, and today many devices—household appliances, computers, lights, and more—run on electricity.



↑ The *North River* was one of the first steamboats in the early 1800s operated on the Hudson River, between New York City and Albany.



↑ A modern industrial electric motor, which, unlike the 18th century version, isn't powered by steam but by oil.



THE GAS GUZZLERS

A few moments later,
the other monsters arrive
at the warehouse...

Here's
the door,
Sulley!



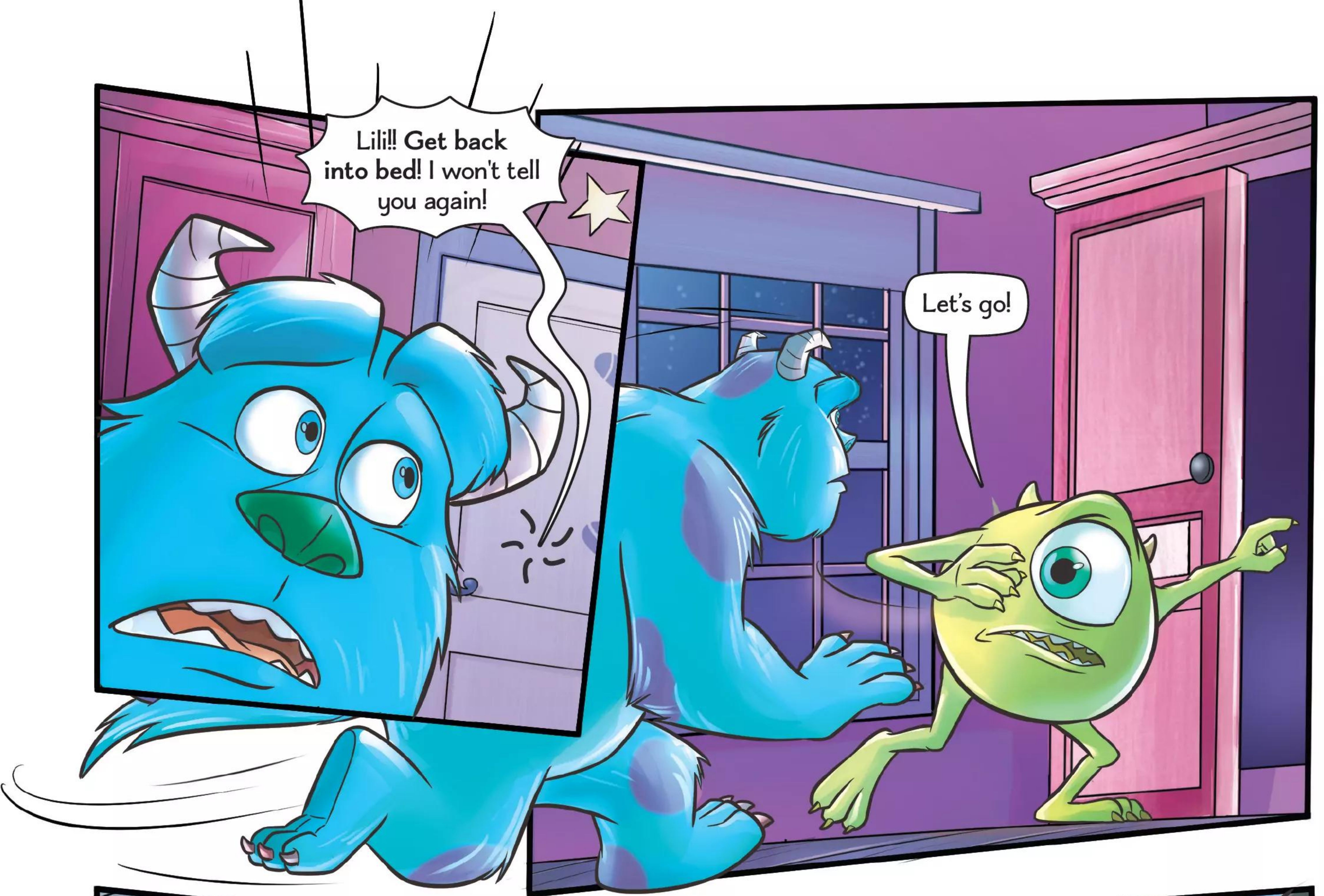
Phew! Good
work, Needleman! They
should give you a raise
around here, hehe!

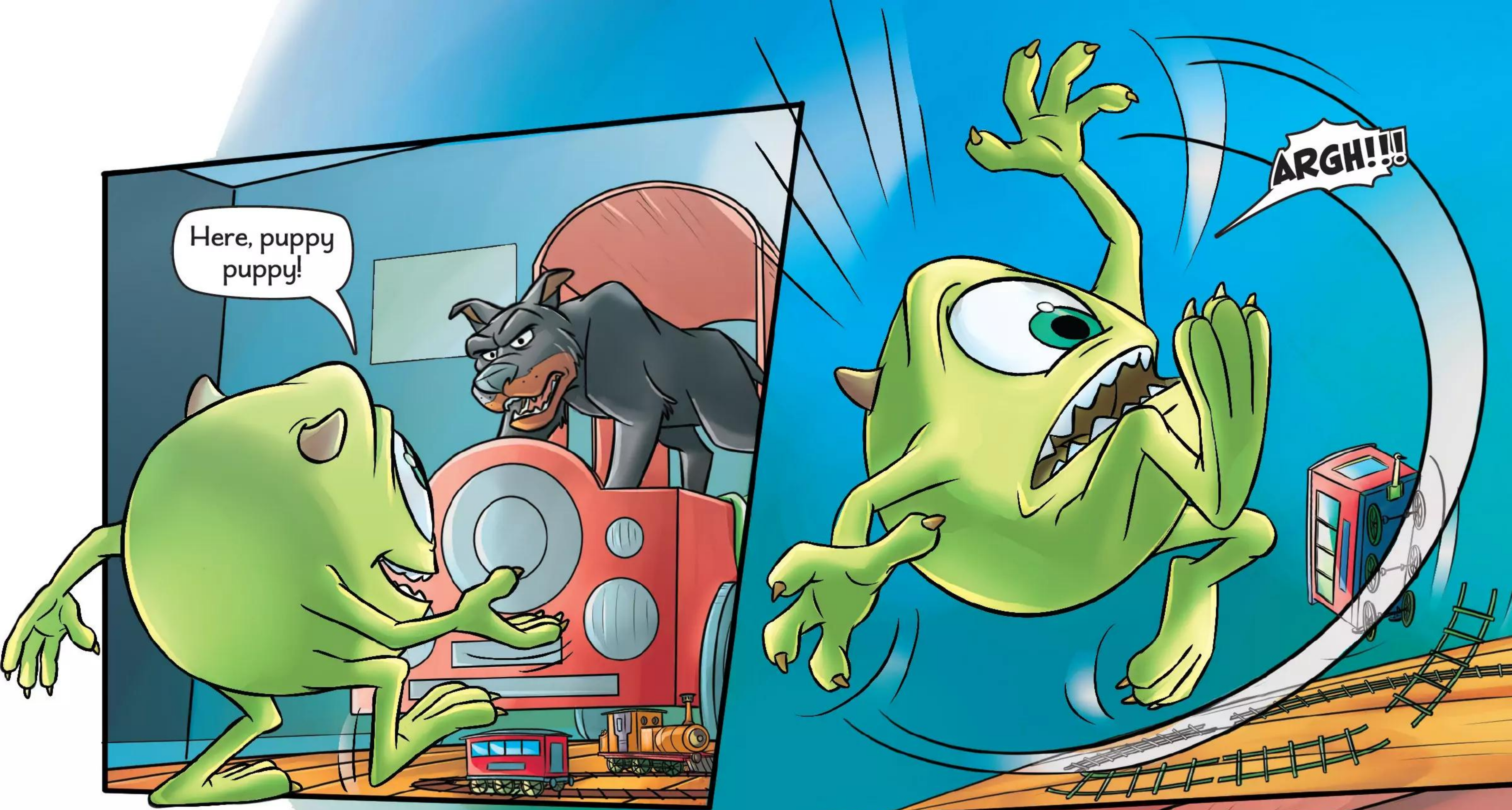
Gee,
thanks!

Come on, Mike,
let's bring Lucy back
before she gets into
any trouble!









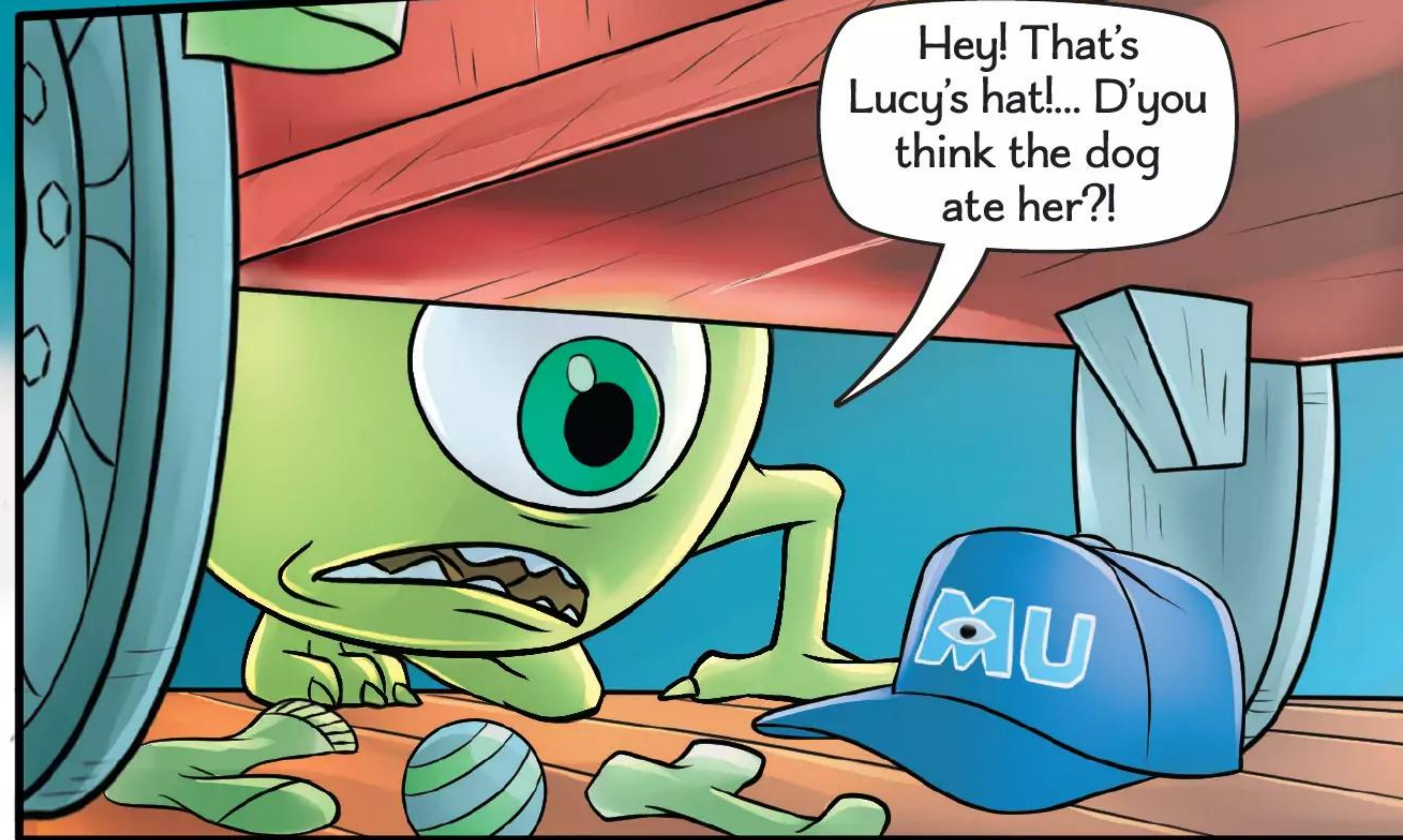
Here, puppy puppy!

ARGH!!!



Ouch.

Enjoy your trip, Mike?



Hey! That's Lucy's hat!... D'you think the dog ate her?!



Nah, he's all bark and no bite.

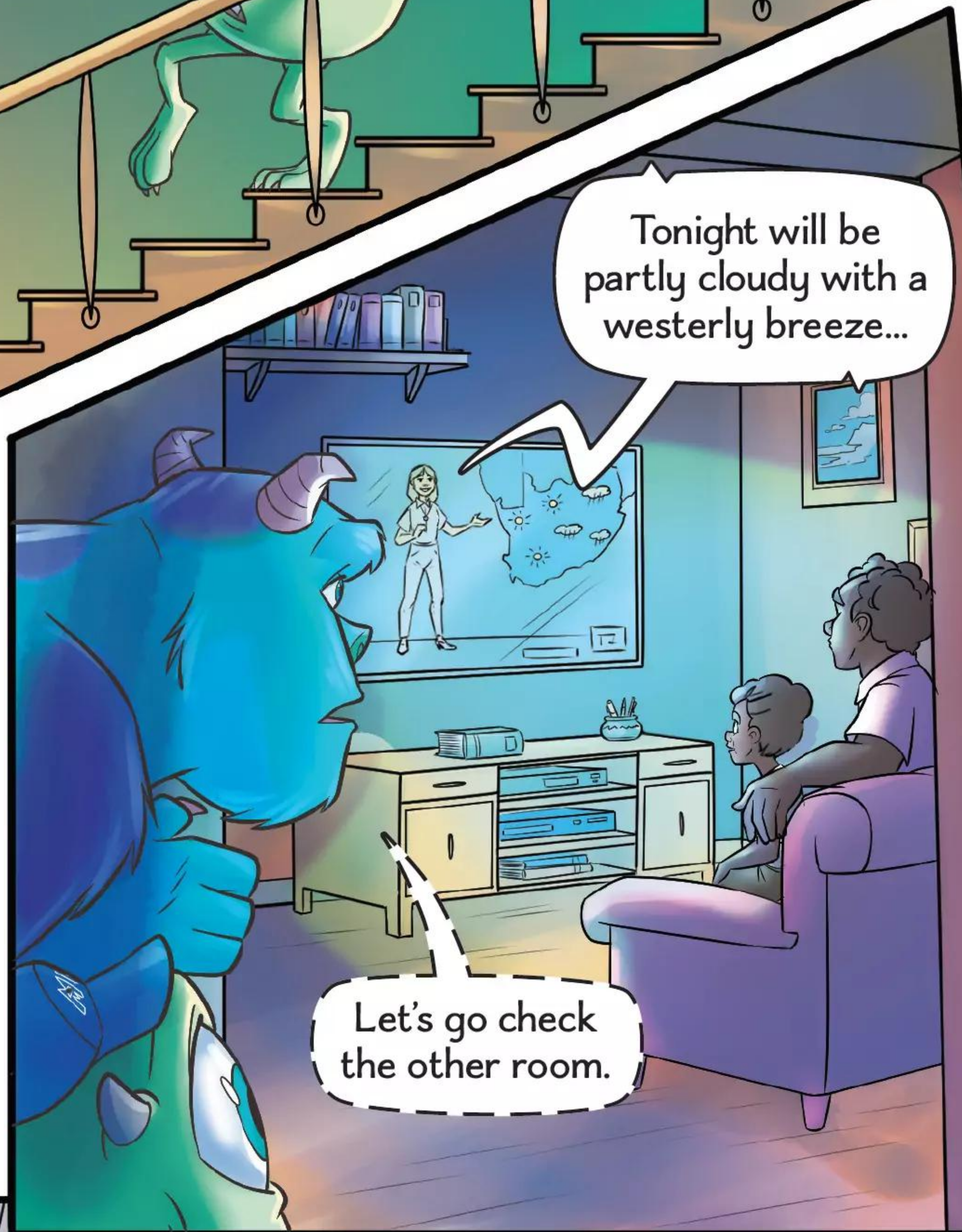
Well, at least we definitely know we're on the right track, eh!

Ha! Let's check the rest of the house, just in case.



I think I can hear a TV on down there...

Shhh!



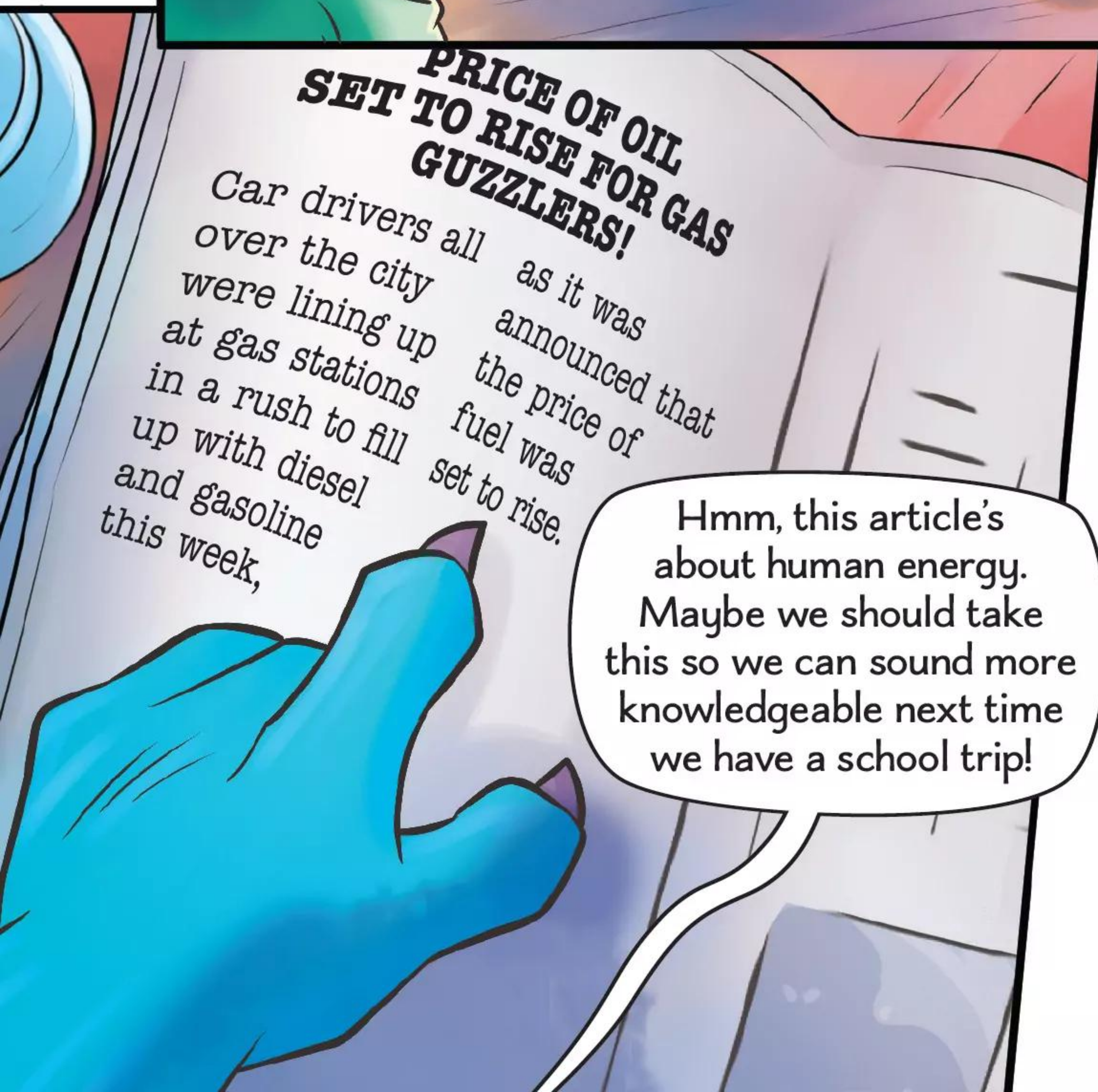
Tonight will be partly cloudy with a westerly breeze...

Let's go check the other room.



Moments later...

I don't think she's here.



PRICE OF OIL SET TO RISE FOR GAS GUZZLERS!

Car drivers all over the city were lining up at gas stations in a rush to fill up with diesel and gasoline this week, as it was announced that the price of fuel was set to rise.

Hmm, this article's about human energy. Maybe we should take this so we can sound more knowledgeable next time we have a school trip!



Come on, let's get outta here!

Meanwhile, on a different continent...

Erm...
I feel a bit dizzy!

Huh?!
Are... are you
a monster?!

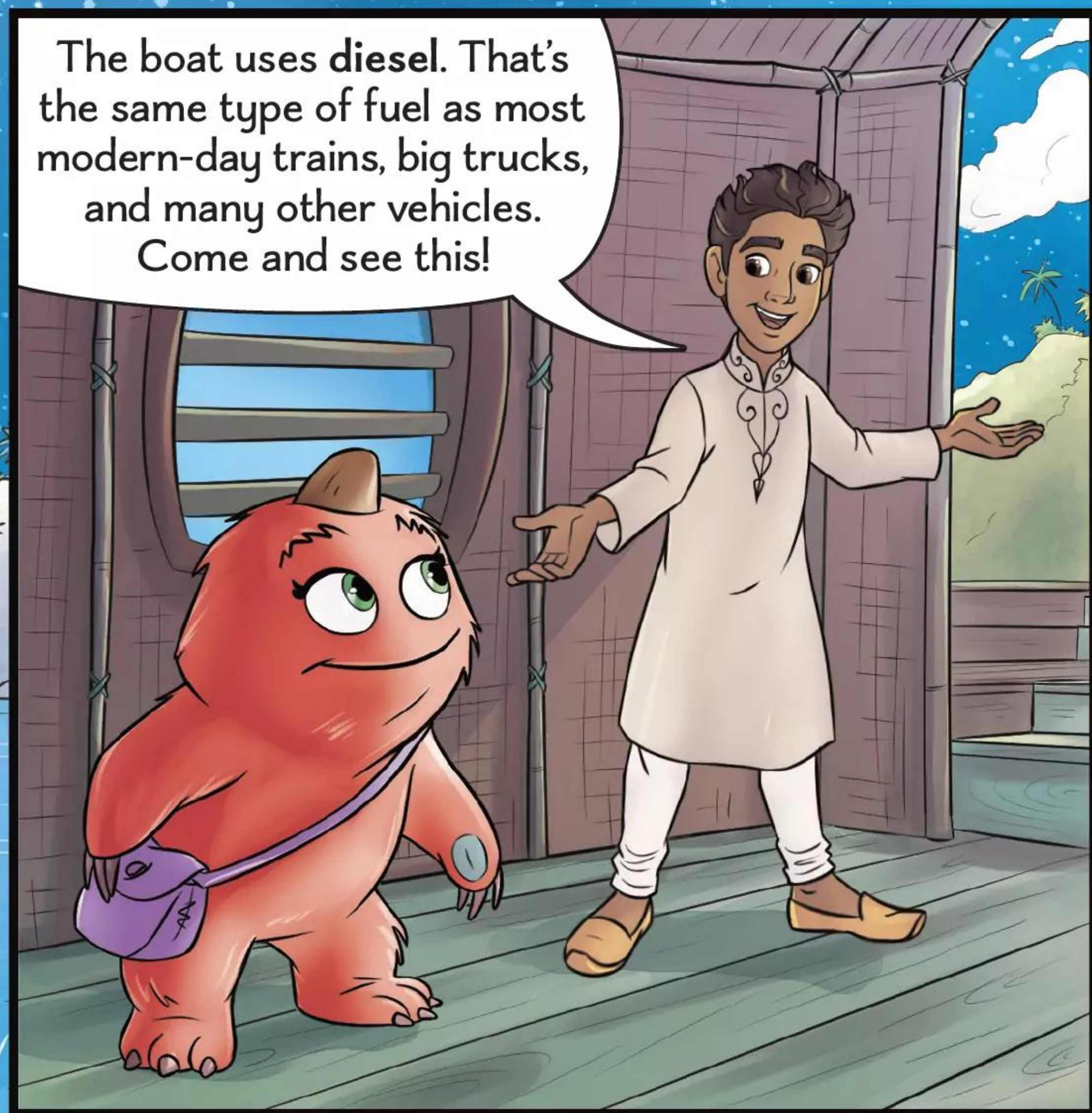
Yes, but a
very harmless one!
Where am I?

You're in Kerala, India.
You can call me Captain
Viraj! Welcome aboard
my houseboat!

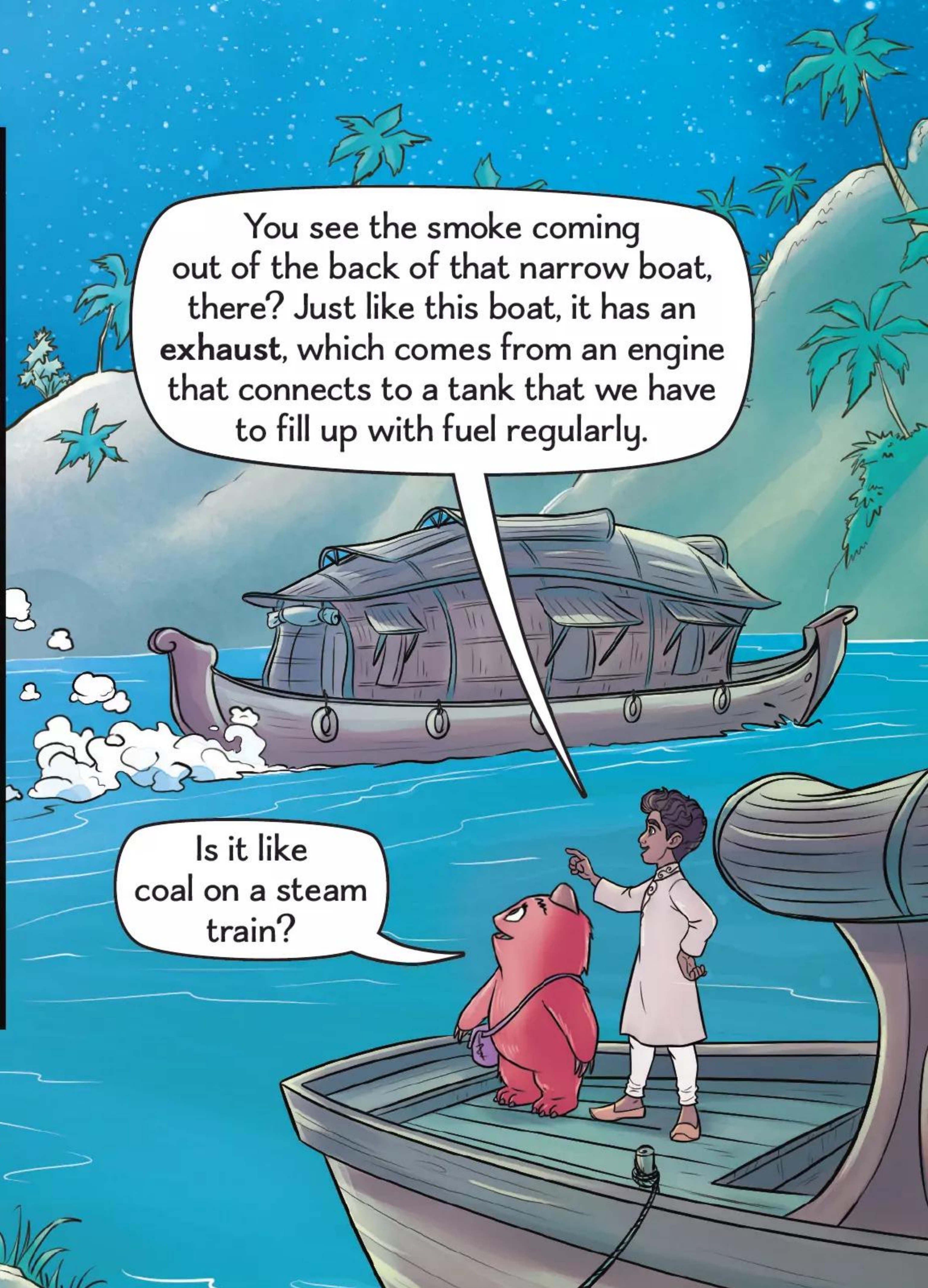
I'm Lucy. You
look a bit young
to be a captain!

Well, it's my
mom's boat, really,
but she's gone
ashore tonight.

I see. I've never
been on a boat before...
How d'you get your
energy?

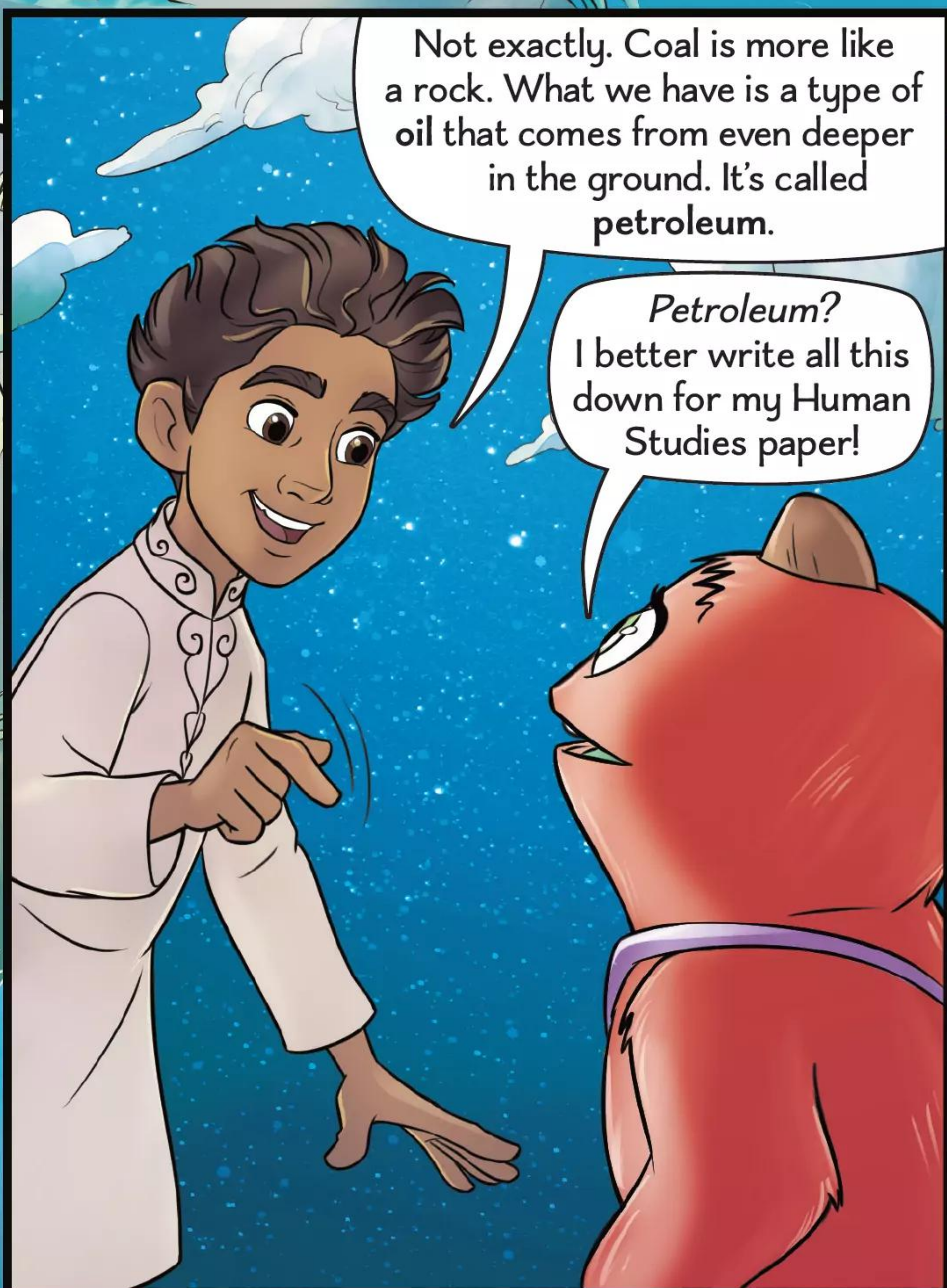


The boat uses diesel. That's the same type of fuel as most modern-day trains, big trucks, and many other vehicles. Come and see this!



You see the smoke coming out of the back of that narrow boat, there? Just like this boat, it has an exhaust, which comes from an engine that connects to a tank that we have to fill up with fuel regularly.

Is it like coal on a steam train?



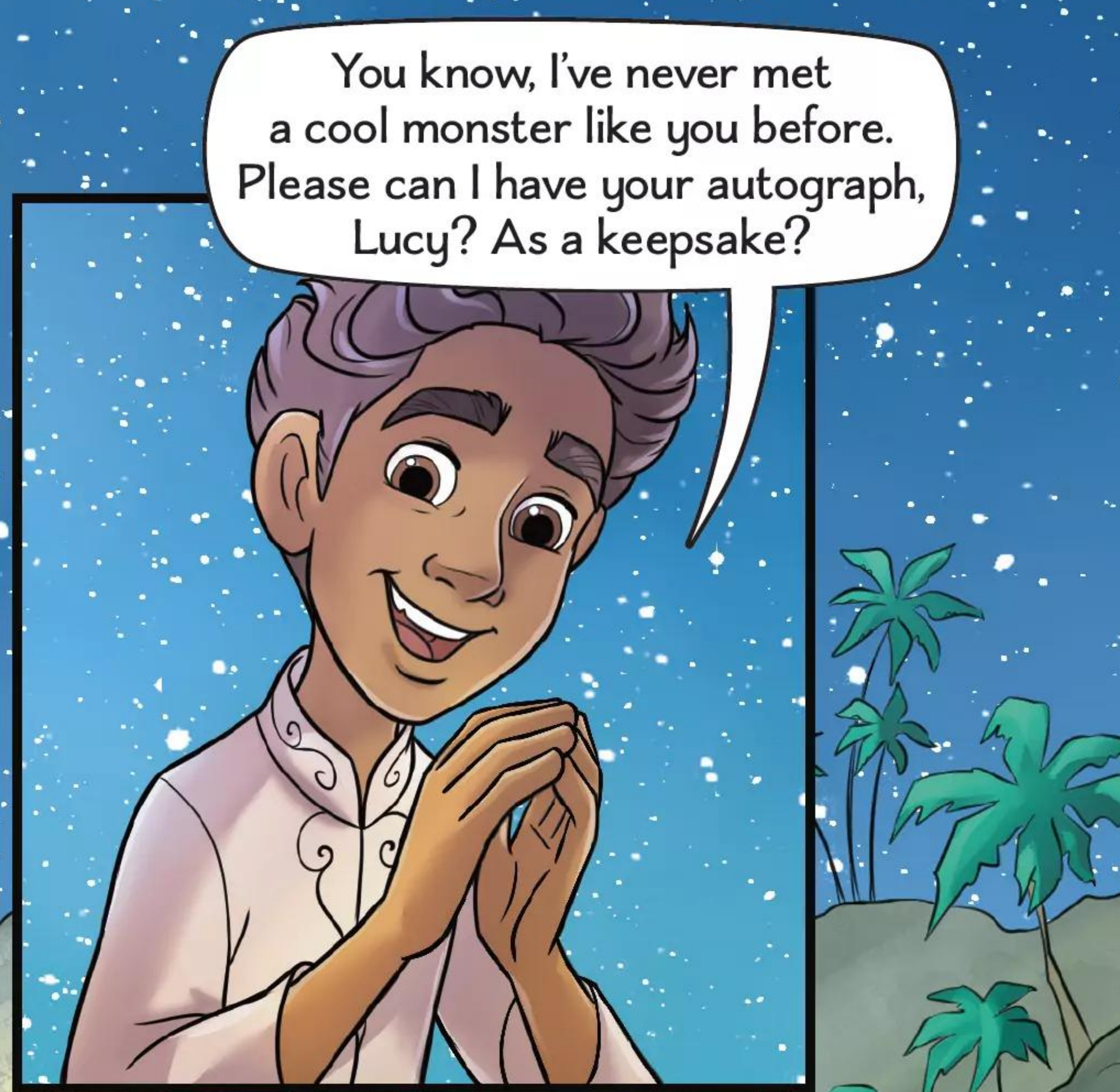
Not exactly. Coal is more like a rock. What we have is a type of oil that comes from even deeper in the ground. It's called petroleum.

Petroleum? I better write all this down for my Human Studies paper!



Yes, petroleum. My teacher taught us that "petra" means "rock" and "oleum" means "oil". Petroleum then has to be refined, going through a sort of a cleaning process, before it gets turned into diesel or gasoline.

Hmm, it's a bit complex!



CONTINUES ON PAGE 51



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OIL AND ITS BY-PRODUCTS

- Where oil comes from
- How an oil field is formed
- The history of oil
- From crude oil to gasoline

➤ Crude oil is a blend of hydrocarbons, substances formed by combining two chemical elements: hydrogen and carbon.

Where oil comes from

ROCK OIL

The word “petroleum” means “**rock oil**” (from the Latin *petra oleum*) and comes from the fact that it is an oil that forms inside underground rocks.

Today, petroleum, or oil, is widely used around the world as fuel. It is a **thick liquid** whose color ranges from dark yellow to brown and black.

Oil is a fossil fuel that forms through mineralization from the remains of prehistoric microorganisms and animals buried underground or beneath the ocean floor. After hundreds of millions of years, these remains are transformed into oil, which accumulates over time to form **oil fields**.



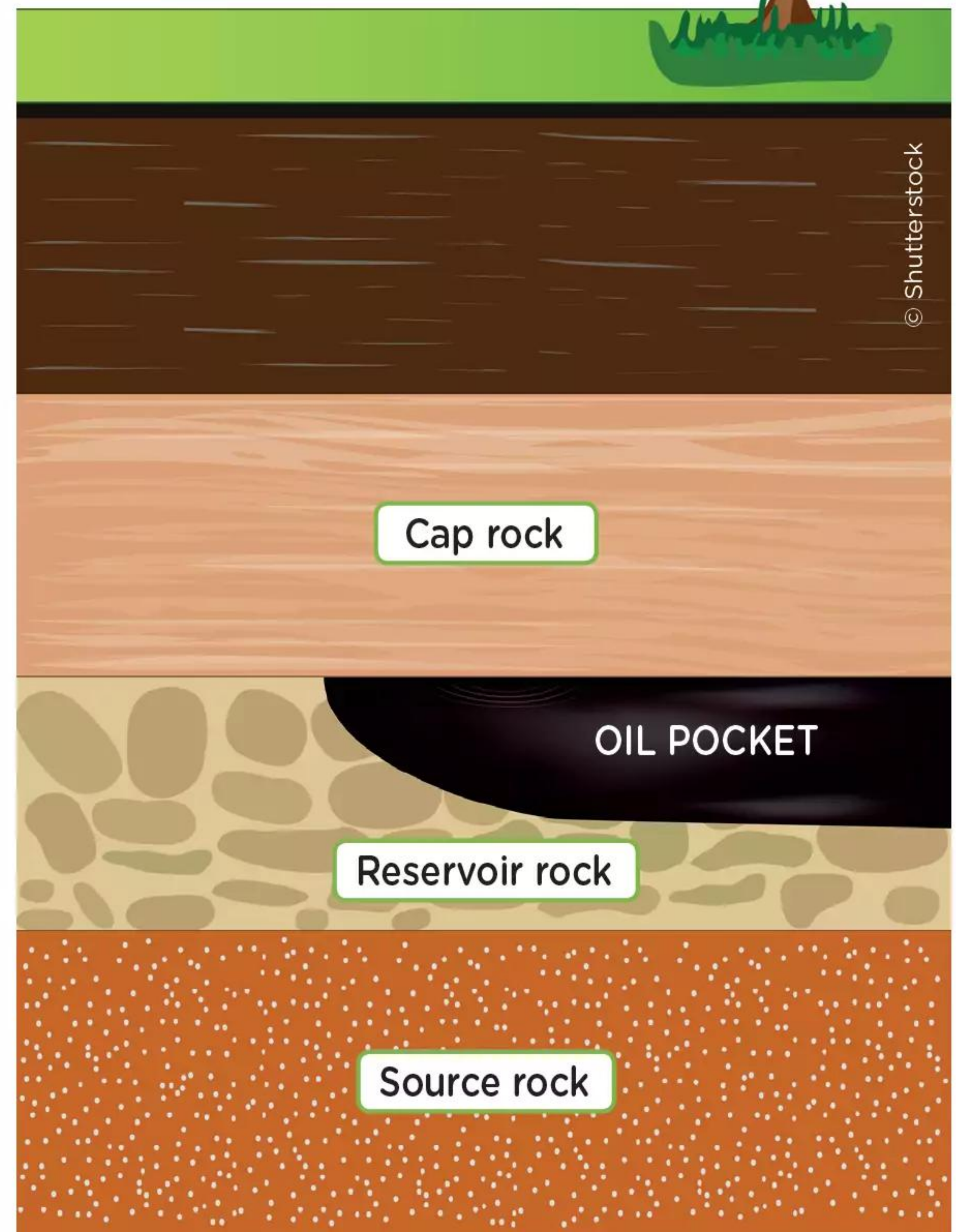
How an oil field is formed

A MATTER OF ROCKS

An **oil field** forms only where there are three specific types of rock. First, there needs to be a very **porous rock**, full of little holes or cracks. The remains of living organisms get deposited inside these holes and are slowly transformed into oil. This type of rock is also called **source rock** because the organic material inside its holes is transformed into hydrocarbons, chemical compounds that are the basic components of oil.

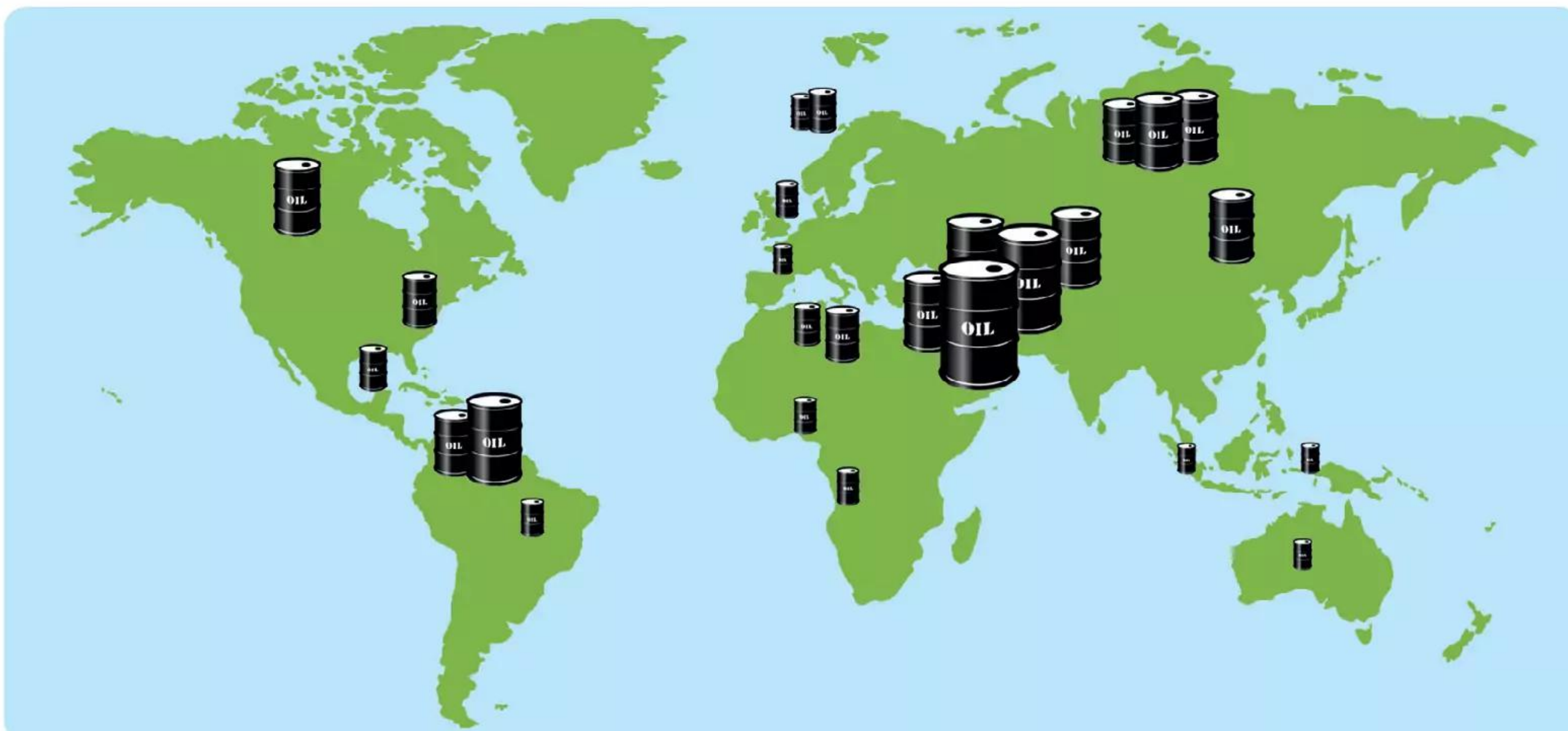
Then there must also be the **reservoir rock**: this is a type of rock that has even more holes and cracks to hold the oil while it is forming and coming out of the source rock. The most common type of reservoir rock is **sandstone**, a very porous rock made of grains of sand. The grains are joined together but there are a lot of empty spaces, so it soaks up the oil like a sponge!

Last, on top of the reservoir rock is another layer called the **cap rock**, which is **waterproof**, that is it doesn't let liquids pass through



↑ The structure of a typical oil field, where oil accumulates over hundreds of millions of years.

it. This last layer covers the oil field and prevents the oil from leaking out of the reservoir rock and rising to the surface. So as time passes, the oil accumulates underground in progressively larger quantities.



← There are many oil fields in the world, especially in the United States, the Gulf of Mexico, the Arabian Peninsula, the Middle East, and Russia.

The history of oil

EARLY USES OF OIL

- Humans have found and used oil since ancient times. For example 6,000 years ago, in Persia, **crude oil**—oil that has just emerged from the rocks—was used to surface roads.
- The Egyptians used it to make the

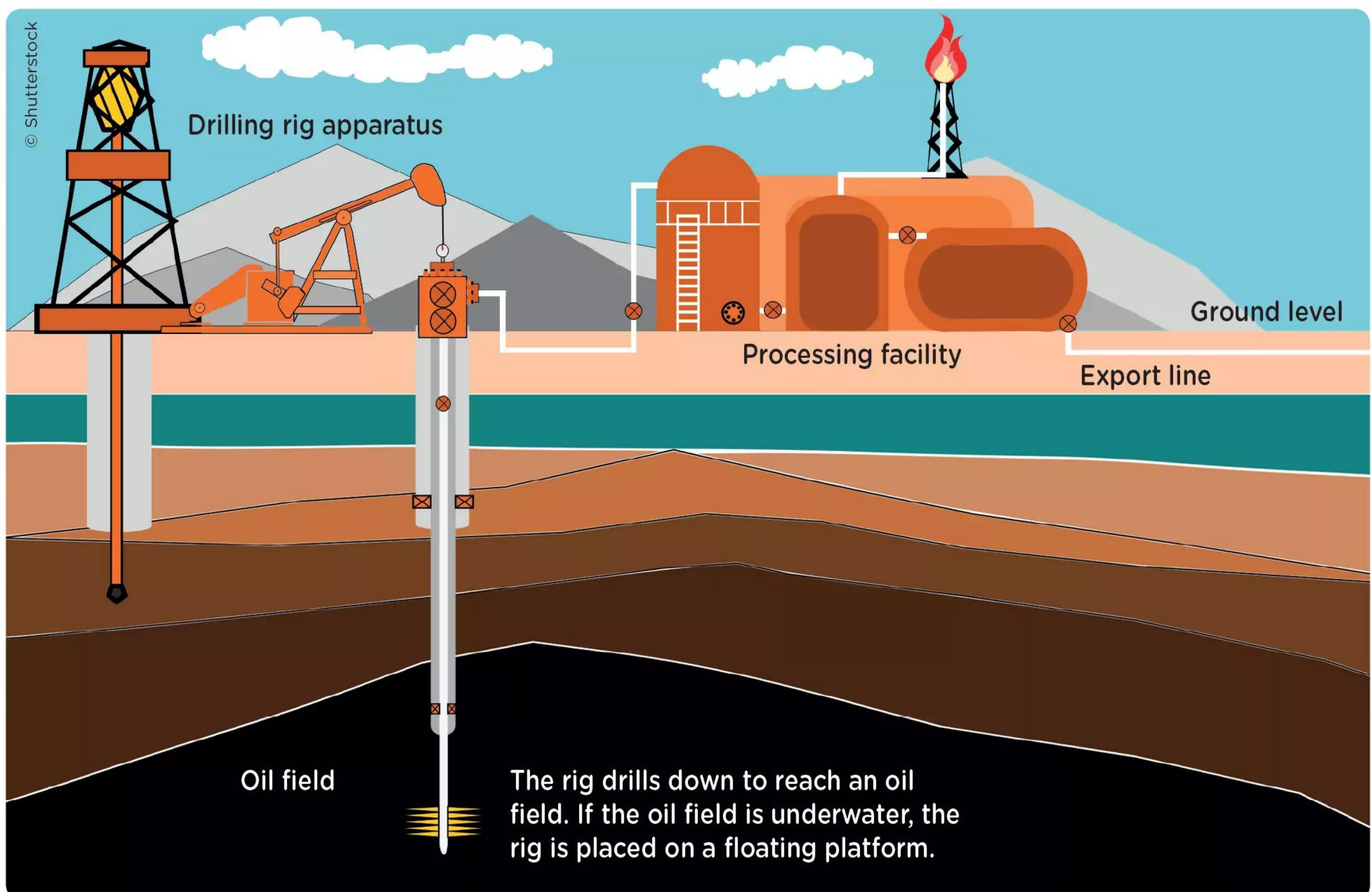
bottoms of their boats waterproof, and the ancient Romans made it into weapons, such as arrows and projectiles that they could set alight and shoot at their enemies. However, when it burns, oil creates thick black smoke with a very unpleasant smell, and that's why ancient peoples didn't often use it to light fires.

EXTRACTION OF OIL

- In the 19th century, American businessman **George Bissell** used “rock oil” as fuel for lamps... and it worked! In order to obtain large quantities of it, he had the first oil wells drilled. These are very deep holes in the ground, 7,000 to 8,000 meters deep, made by machines called drilling rigs, which look like

giant drills. When the end of the rig reaches an oil field, a pipe is inserted into the hole to **extract the oil** and bring it up to the surface.

Oil is found in many places on Earth, with some of them easier to reach with rigs: oil fields close to the surface, for example, or those on types of terrain obstructed by fewer underground rocks, which makes drilling a well easier.



From crude oil to gasoline

TOWARD AUTOMOBILES

In the second half of the 19th century, the **heat engine**, also known as the **combustion engine**, was invented. This engine is smaller and more practical than the steam engine and can move small vehicles like automobiles, which were invented straight after. When **automobiles** spread all over the world, oil became

very valuable: it actually became known as “black gold.”

The fuel used in cars is, in fact, a by-product of oil called **gasoline**. Once extracted, the crude oil is taken to a **refinery**, a facility where the various substances making up the oil are separated and then processed to produce gasoline, along with other compounds such as **diesel fuel**, for example, and **plastic**.



TRANSPORTING OIL

There are several ways to transport oil to the refinery. The most common way is to build **pipelines**, networks of large pipes through which the oil flows to its destination. Otherwise, the oil can be transported by road inside **tank trucks**, or by rail in **rail tankers**. Oil can also be loaded onto oil **tanker ships**.

Despite the heavy usage of oil these days, it is important to realize that its transportation uses energy, which is also often produced by oil. What's more, when oil ends up in the

environment by accident—if it leaks from cisterns or tanks—it can pollute the sea and land, seriously damaging the natural surroundings.

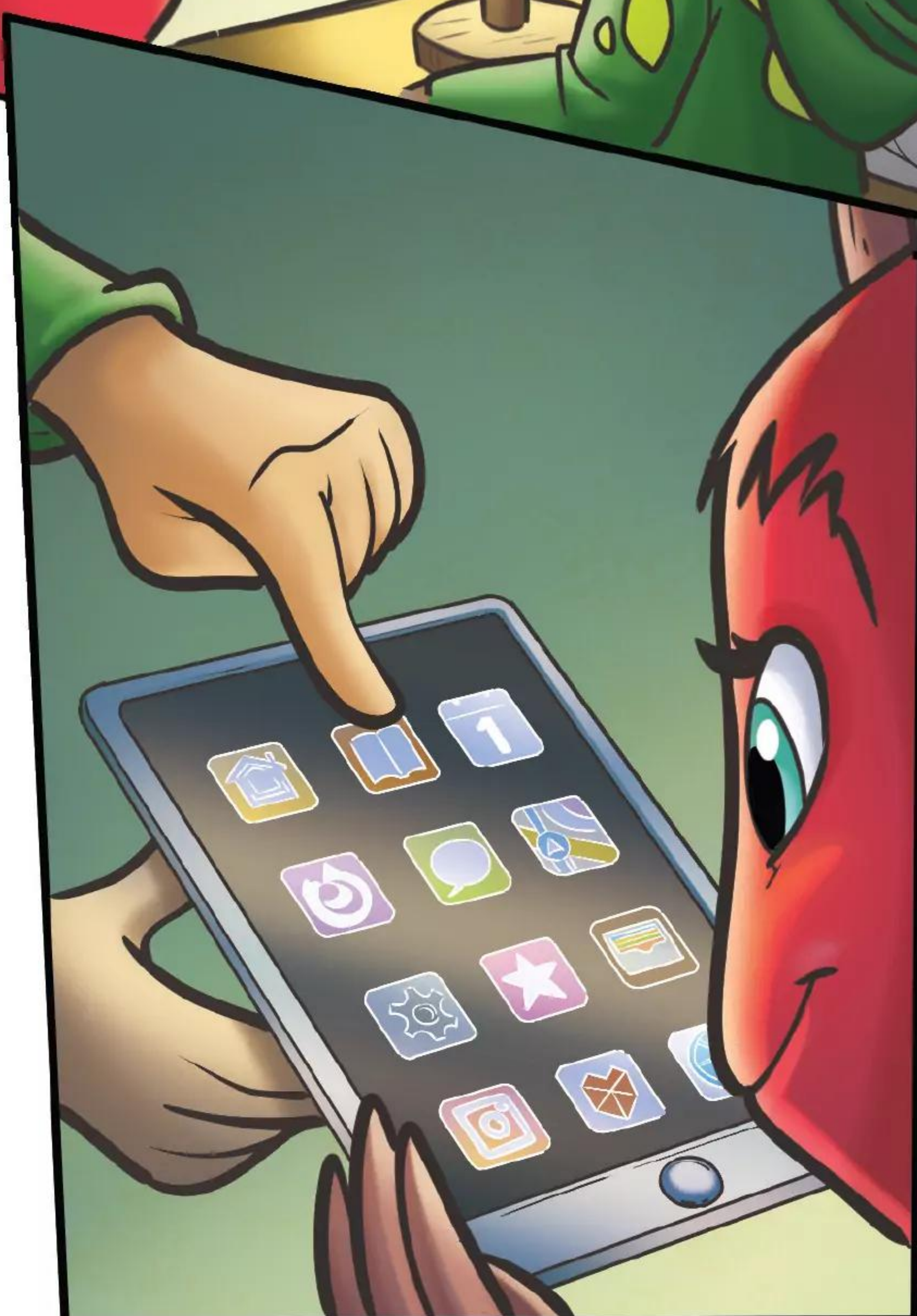


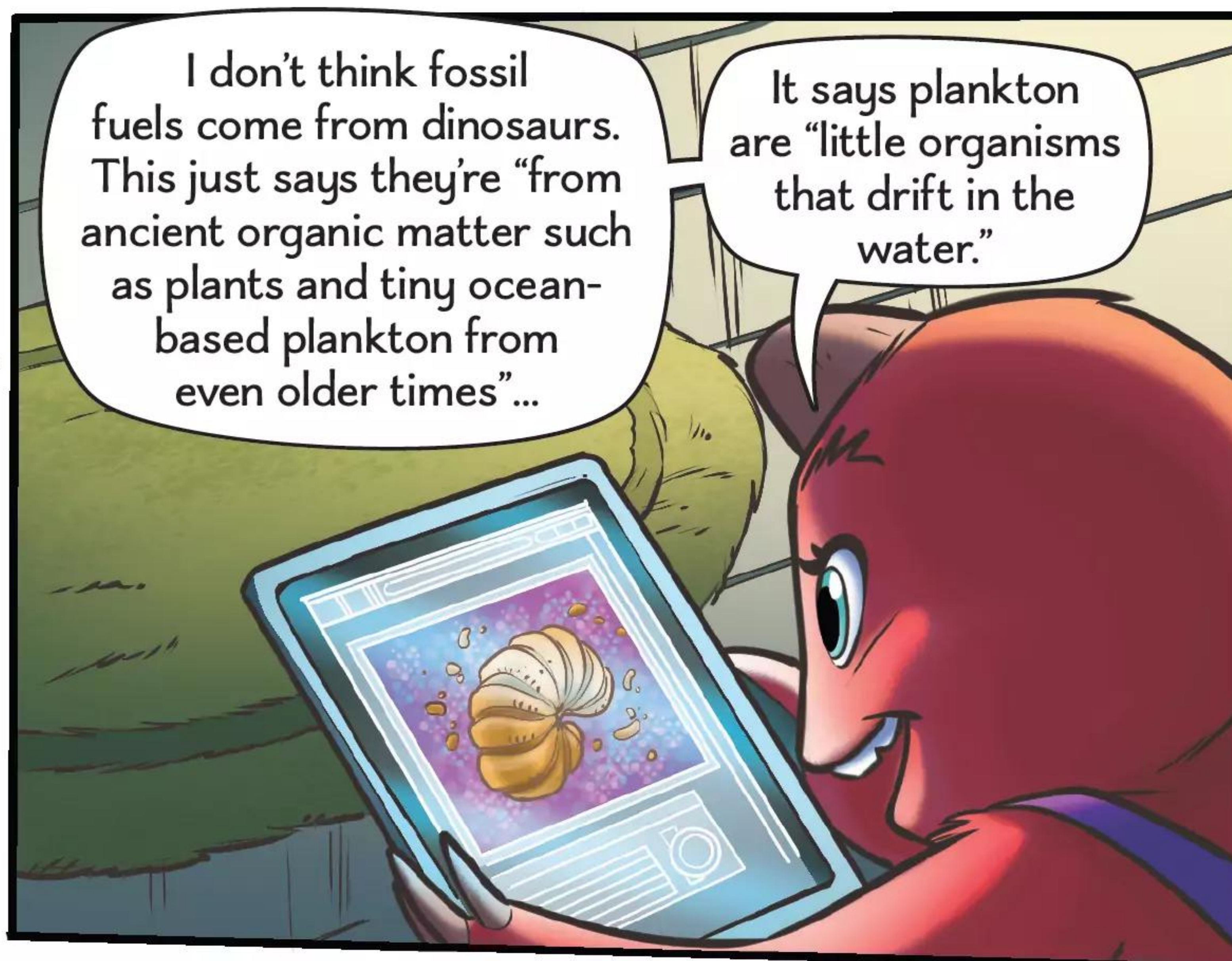
➤ A spill from an oil tanker can pollute the sea and the beach. Oil must be cleaned up quickly to help nature recover.

FROM FOSSIL TO FUEL

Lucy continues her exploration of human energy by going through another door, ending up in Tokyo, Japan...

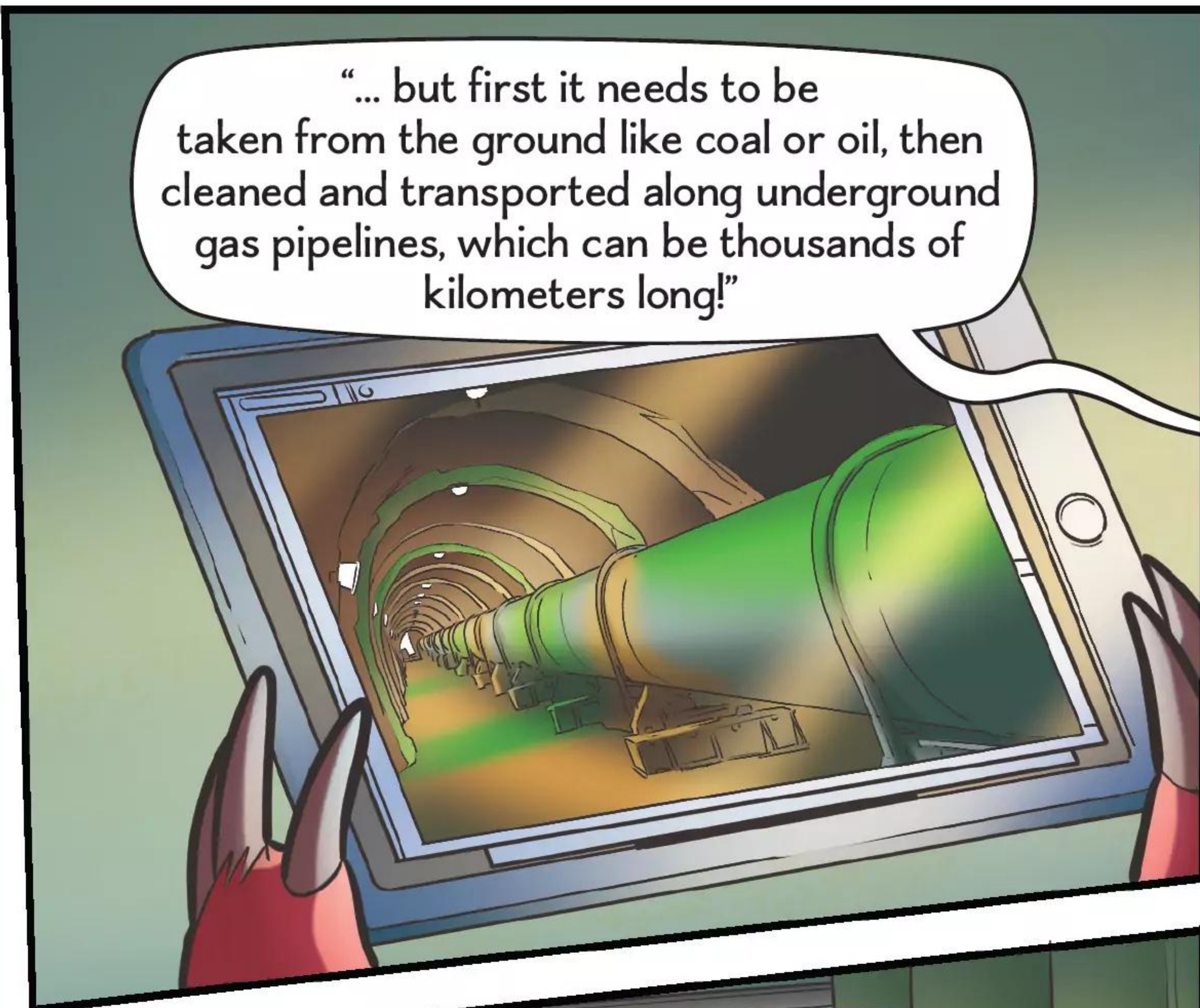








It also says here that "natural gas burns very easily, which makes it very popular in homes all over the world for heating and cooking..."



"... but first it needs to be taken from the ground like coal or oil, then cleaned and transported along underground gas pipelines, which can be thousands of kilometers long!"



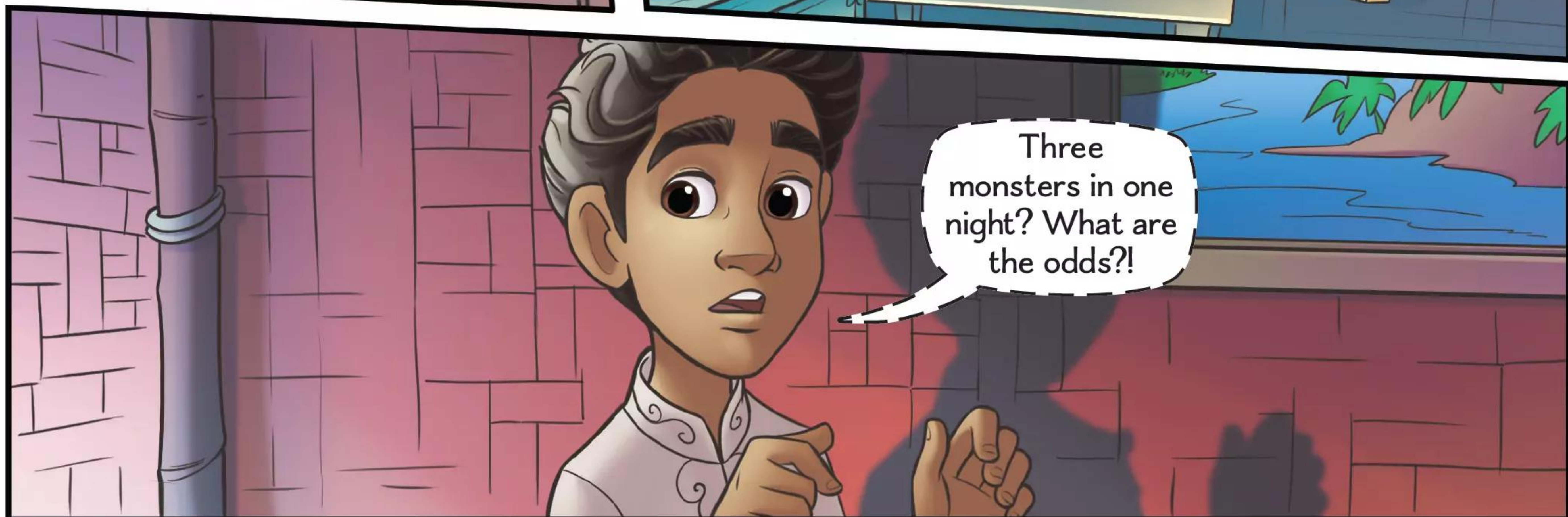
ಽYawnಽ My obaachan* always says that gas is the fastest way to cook rice, because it heats up so quickly!



I wonder if there's something else to use besides fossil fuels, but I'd better let you sleep.



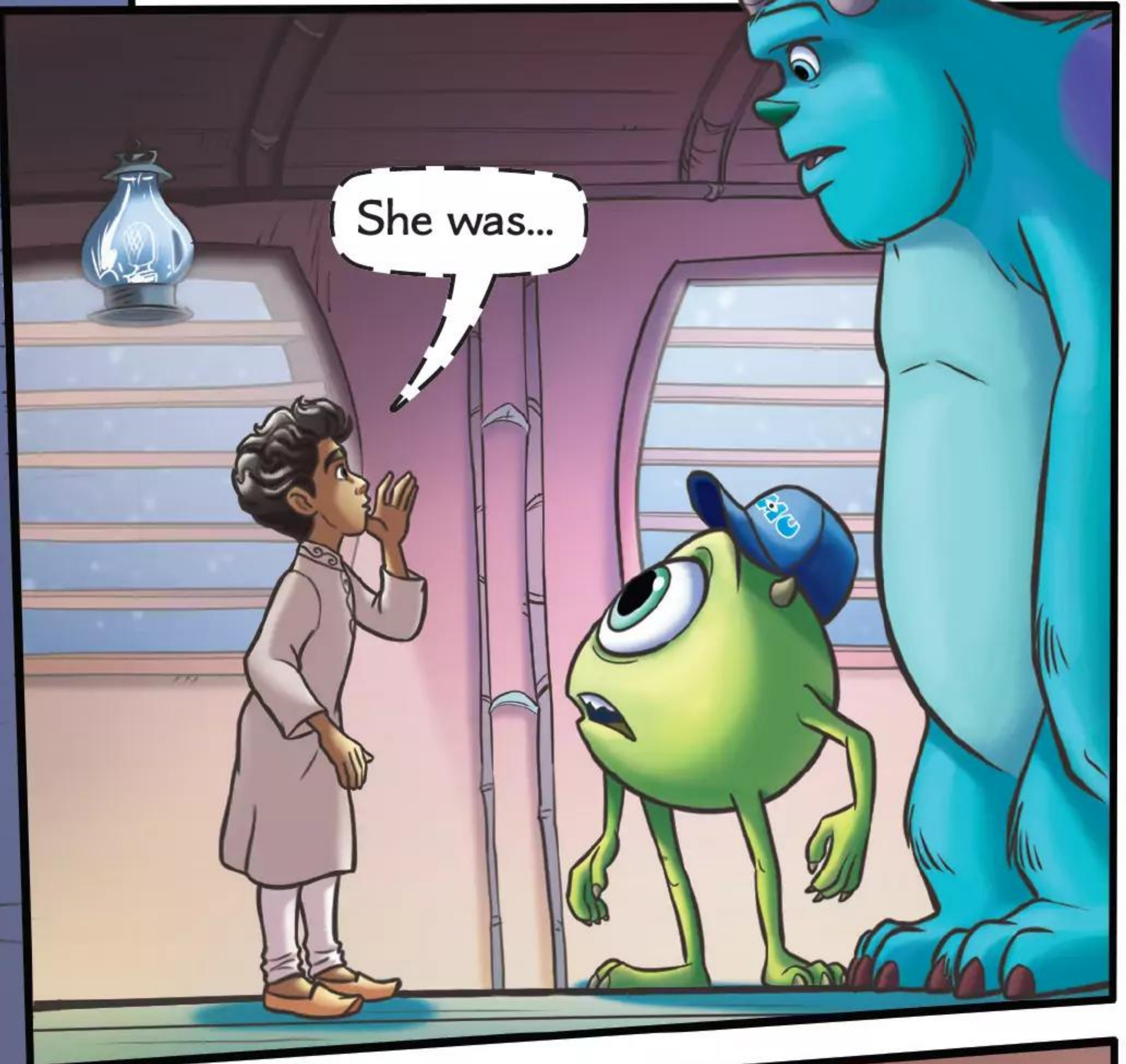
* Obaachan = "Grandma" in Japanese





Seems like our friend Lucy has already paid you a visit!

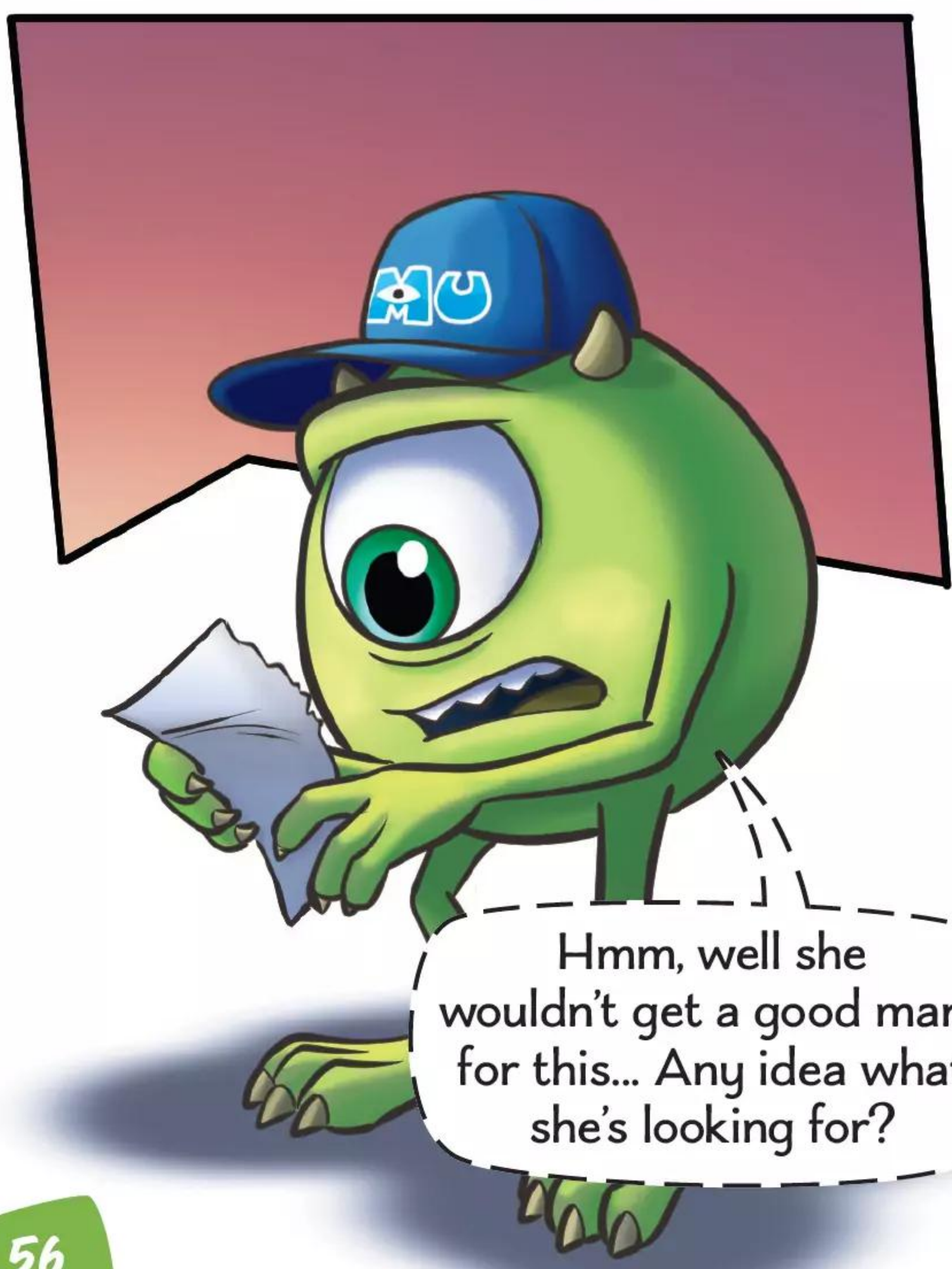
Is she here?



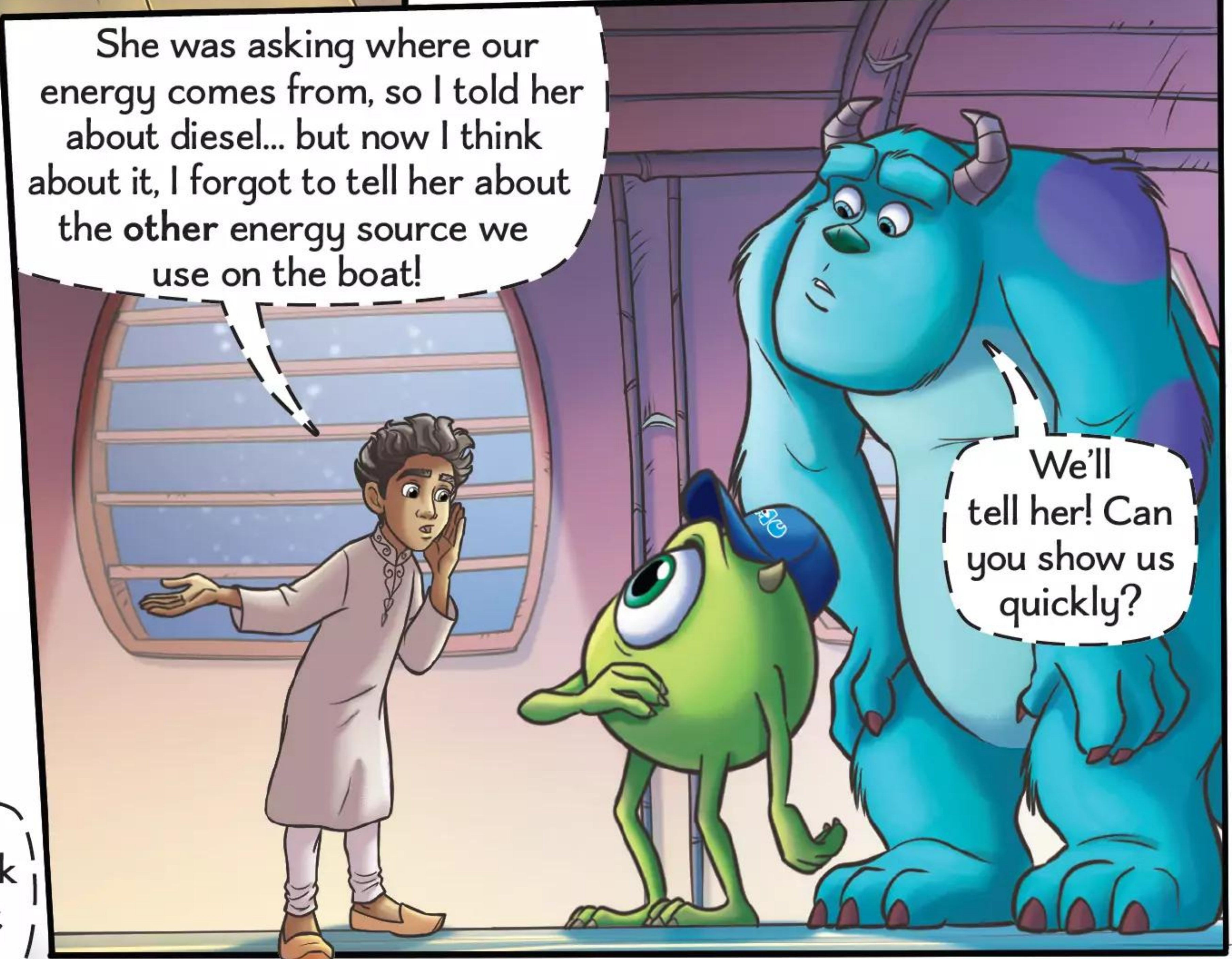
She was...



She's doing research for her Human Studies paper!



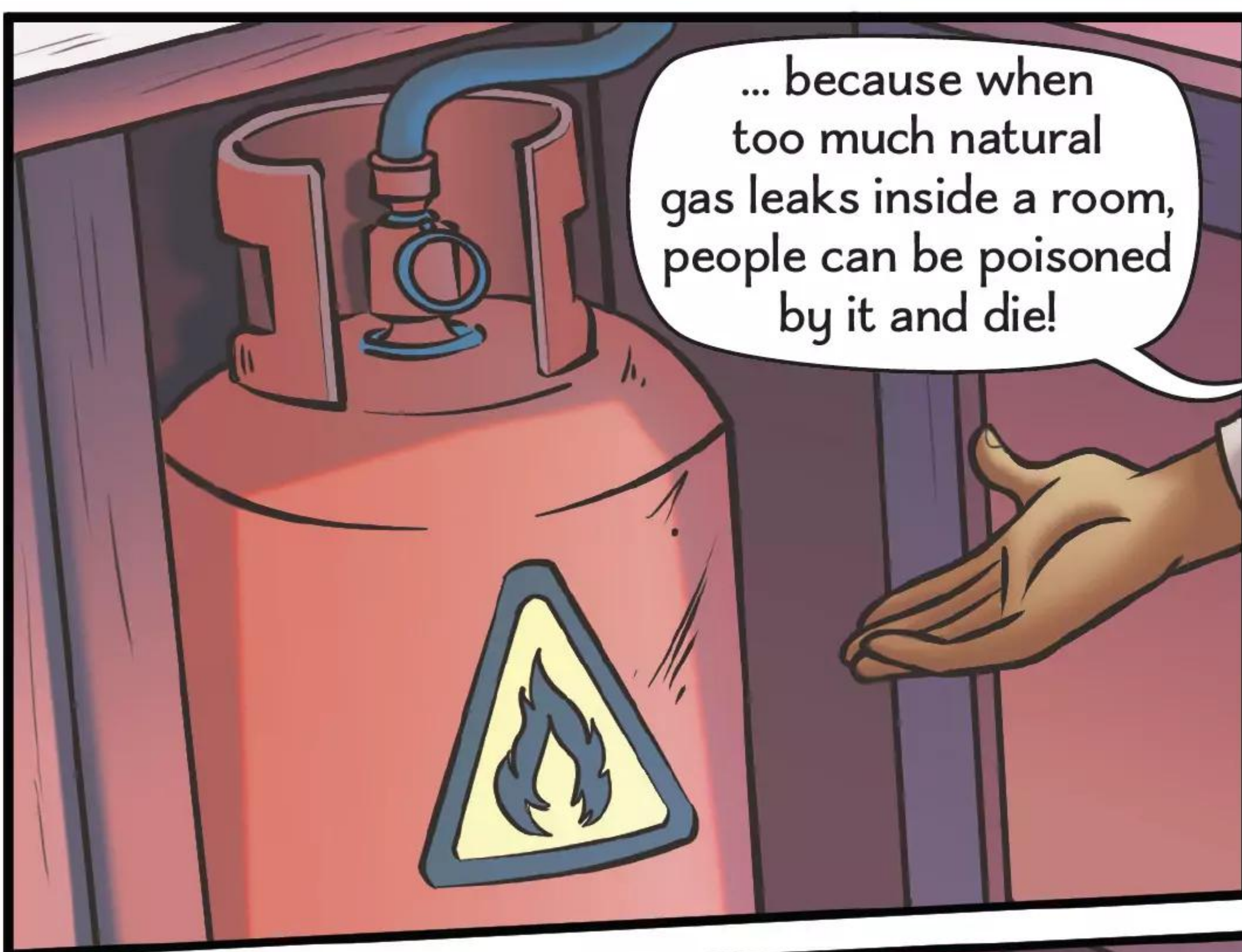
Hmm, well she wouldn't get a good mark for this... Any idea what she's looking for?



She was asking where our energy comes from, so I told her about diesel... but now I think about it, I forgot to tell her about the other energy source we use on the boat!

We'll tell her! Can you show us quickly?





CONTINUES ON PAGE 63

NATURAL GAS

- Where gas comes from
- The history of natural gas
- The many uses of methane
- Natural gas today



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Where gas comes from

NEITHER LIQUID NOR SOLID

Natural gas is a fossil fuel found in nature, in underground or underwater gas fields. It is neither liquid, like oil, nor solid, like coal. It is made of a **blend of gaseous substances**, mainly **methane** (CH_4), but also carbon dioxide, nitrogen, hydrogen sulfide, and helium. Some of these are dangerous substances because



Gases tend to occupy all the space around them, so when small holes form on the ocean floor over reservoirs, bubbles of natural gas rise up from below to fill the new space.

they are highly flammable: if they are near a spark or any heat source, they catch fire easily. What's more, they are poisonous if breathed.

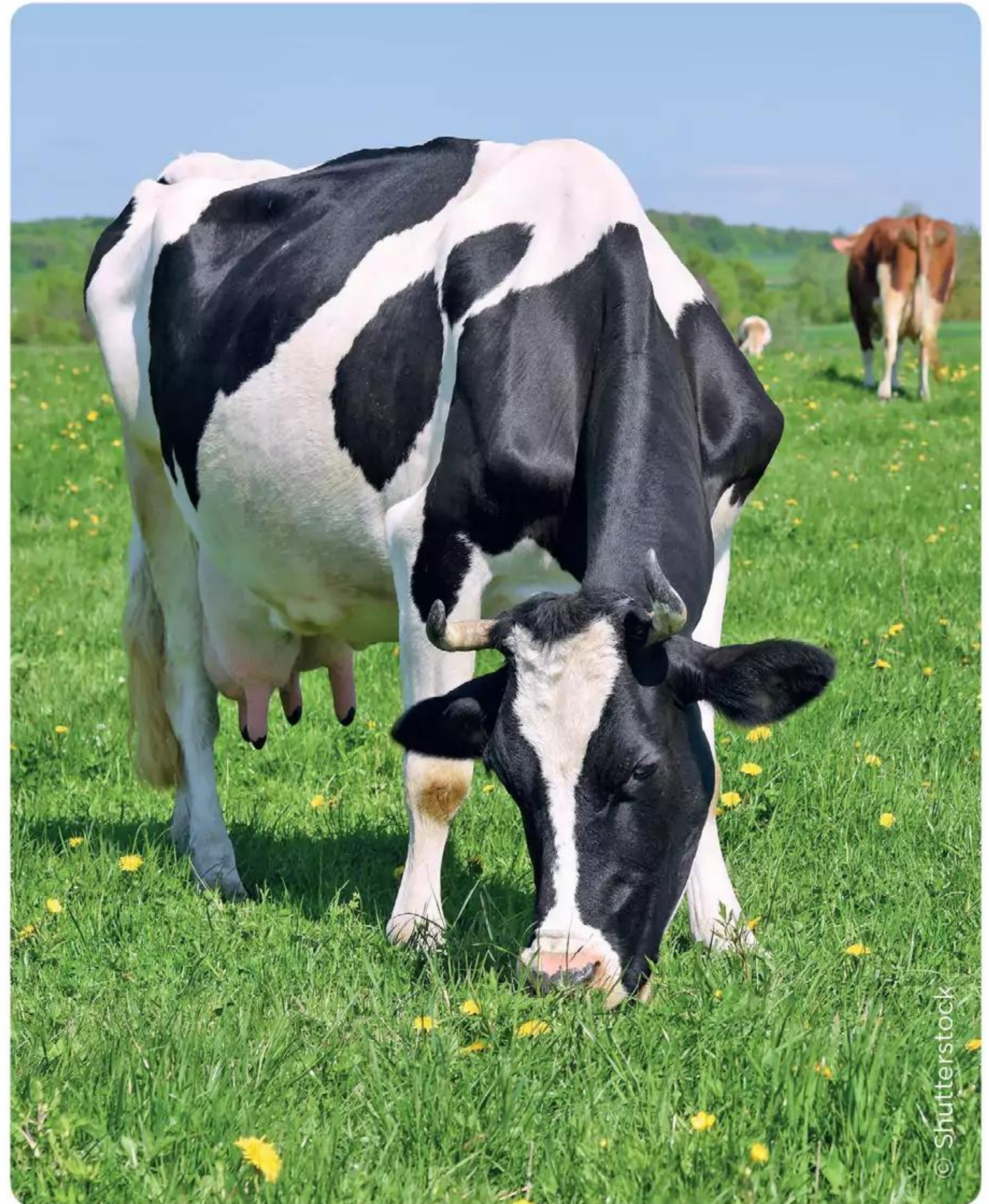
Natural gas is almost always found in the same fields as oil because it is formed by the same process, and over the same periods of time, but from a mixture of gaseous, rather than liquid, compounds.

The history of natural gas

METHANE

The main component of natural gas is methane, a **hydrocarbon** also found in the atmosphere. When the Earth was still being formed, there was actually a lot of methane in the air, which was important because, together with water and other substances, it took part in the chemical reactions that led to the creation of the first living microorganisms.

What's more, methane can also be generated by living beings, such as microorganisms like bacteria and large animals like mammals, especially cows. It's produced during the **digestion of food** and then released into the air.



➤ When ruminant animals like cows digest the grass they eat, methane is produced in their stomachs and then released into the atmosphere.

A GAS THAT BURNS

Since ancient times, humans have found methane easily: for example, near oil that sprang naturally from the earth, or in the caves where they collected coal. So they learned how to use it to light fires. And that's not all: over 2,500 years ago, in China, people transported methane through a system of sealed bamboo pipes to light their homes.

In Europe, on the other hand, people began using it in the 19th century. This was thanks to Italian scientist **Alessandro Volta**, who noticed the gas bubbles that rose to the surface from the bottom of a lake. So he put a match near the bubbles, igniting

blue flames. This is how Volta understood that methane could be used as a fuel.



➤ The gas that escapes from the earth can burn for a long time. For example, at the foot of a mountain near the Olympos valley in Antalya, Turkey, there are fires that have been burning for 2,500 years.

The many uses of methane

LAMPS AND STOVES

In Europe, the first **gas lighting system** was installed in 1806, to light the **lamps** in a large English cotton mill near Manchester. Then, in 1821, the streets of a whole city, **Fredonia**, near New York, were lit using methane. Gas spontaneously emerging from a hole in the ground was transported to the lamps in the city by a network of pipes. Later, gas lighting systems became widespread in many European and American cities.

Toward the end of the 19th century, gas began to be burned as a fuel to power machinery in factories. In 1885 in Pittsburgh, in the United States, there were already 800 kilometers of pipelines to transport methane gas to companies. Last, in the 20th century, methane was widely used as the main **domestic fuel**: in the



↑ Methane is odorless, so it is mixed with other substances that do have a smell. That way, if there's a gas leak, you can smell it in the air.

kitchen, with **gas stoves** to cook food, and with boilers to heat homes and water. The methane was brought inside homes in tanks or bottles, which were then attached to the cooking and heating systems in the house. Later, boilers and stoves were directly connected to a structured system of gas pipelines.



Natural gas today

MORE RELIABLE AND EFFICIENT

Today natural gas is also widely used as a fuel in **power stations**, to produce electricity. That's mainly because there's more of it than oil and coal. Its deposits are abundant and better distributed geographically.

However, in order to use it, it has to be transported from the gas fields with carrier ships, in special containers. Or, in the same way as it happens with oil, by using **gas pipelines**, which are networks consisting of very long pipes, through which the gas flows thanks to powerful pumps. Sometimes gas is compressed or cooled for transportation so that it becomes a liquid and occupies less space.

As well as being abundant and less difficult to extract, natural gas has another advantage over other fossil



↑ With gas pipelines, long networks of pipes make it possible to transport natural gas even across large distances.

fuels: when it burns, it produces the same energy as oil and coal, but in the same period of time it **pollutes less**. Still, even natural gas can be dangerous for the environment. In fact, when it burns, it produces carbon dioxide, which is one of the substances responsible for global warming. That's why scientists are looking for new ways to produce energy without using fossil fuels.

